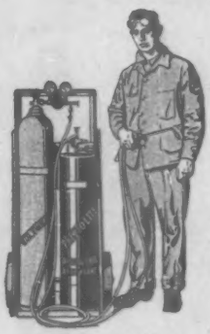
Of this issue more than 4000 copies were printed

The Welding Engineer

Vol. II. Chicago 608 S. Dearborn St. MARCH, 1917 $2.00 per year in U. S. $2.50 per year abroad No. 3

Oxy-Acetylene Welding and Cutting

No matter what welding process you now use, you need this also



No matter what other welding methods are now employed in your shop or factory, the Prest-O-Lite Process will pay you additional dividends. It will handle certain work quicker, cheaper and better than other methods. In many cases the added strength, economy of labor and material so easily effected by the Prest-O-Lite Process are entirely outside the range of other welding processes.

The perfect portability of this outfit makes it far superior and more profitable than a stationary outfit —it is ready for instant use inside or outside the shop. In everyday repair work, the outfit will save its initial cost many times over, in a very short time.

You may be using other welding processes with profit but some place in your shop or factory there is also a real need for the Prest-O-Lite Process.

Our welding literature is full of helpful suggestions to manufacturers and engineers. Write for it.

The Prest-O-Lite Company, Inc.
The World's Largest Makers of Dissolved Acetylene.

Main Office and Factory, 851 Speedway, Indianapolis, Ind.
Canadian Office and Factory, Merritton, Ontario, Canada.

Prest-O-Lite PROCESS

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The largest makers of Oxy-Acetylene Welding and Cutting Equipment and Supplies in the World

Oxweld Equipment includes Acetylene Generators, Welding and Cutting Blow Pipes, Regulators and Supplies—everything needed for all requirements—complete installations for the most extensive manufacturing and repair operations to portable units for emergency and field use. Because of the scientific accuracy and exactness of design—high quality materials and the mechanical perfection of construction and workmanship, **OXWELD EQUIPMENT** will produce the most efficient and economical results in welding and cutting operations of every character.

Oxweld Supplies are made up in accordance with the formulae of our metallurgists—tested by analysis in our laboratory and their merits tested out and proven by our expert welders in actual shop practice. We guarantee **OXWELD SUPPLIES,** when used by competent welders, to produce better results than any others known to the art today.

Our knowledge and experience, as the largest makers of welding and cutting equipment in the world, are always at the service of every purchaser and prospective purchaser of **OXWELD APPARATUS,** to determine the most economical and efficient applications of the **PROCESS** to the manufacturing or repair problems at hand.

Write us for information on any class of Welding or Cutting Work

Oxweld Acetylene Company

CHICAGO
36th St. and Jasper Place

NEWARK, N. J.
6460-680 Frelinghuysen Ave.

LOS ANGELES
654-656 Pacific Electric Bldg.

BECOME A PROFESSIONAL WELDER

We teach you to become an expert in this profitable field of work. The demand for men trained in the art of Autogenous welding and cutting is far greater than supply. Opportunities are greater than in any branch of mechanics.

You learn by having to do practical welding with your own hands, under the instruction of expert operators, as well as from carefully prepared text books and lectures.

The Chicago Welding Institute occupies all of this new building. It contains, besides class rooms and offices, lockers and shower baths, the best equipped welding shop in the country. The oxy-acetylene cutting and welding equipment used is of the best make—each student having his individual outfit and place to work. A regular line of custom work is taken in at this shop and the student can observe practical men welding and cutting under commercial condition. He is also given personal instruction, and under the eye of experts performs similar work with his own torch. We give a thorough, practical and up-to-the-minute course in all branches of this art—the student staying until he is letter-perfect.

Send for full particulars concerning the course and cost of instruction.

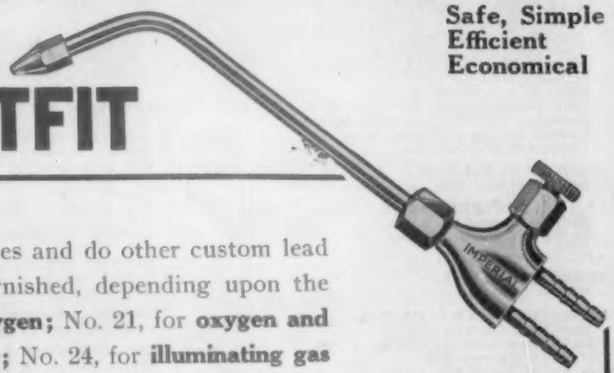
CHICAGO WELDING INSTITUTE

522 South Racine Ave.

CHICAGO

IMPERIAL LEAD-BURNING OUTFIT

Safe, Simple Efficient Economical



This outfit enables you to burn storage battery plates and do other custom lead burning quickly and efficiently. Four styles are furnished, depending upon the gases you wish to use: No. 20, for **acetylene and oxygen;** No. 21, for **oxygen and hydrogen;** No. 22, for **hydrogen and compressed air;** No. 24, for **illuminating gas and oxygen.**

The apparatus is adapted to nearly every condition of the shop, at minimum cost, insuring the greatest possible safety. It consists of a small torch which produces a needle point flame best adapted to the purpose, together with gas regulating equipment. If you already have an oxy-acetylene welding outfit, the lead burning torch, bench block, hose and connections are all you need to buy.

We also manufacture a full line of the well-known **Imperial Oxy-Acetylene Cutting and Welding Equipment,** which will weld anything in metal and cut anything in wrought iron or steel.

Send for descriptive literature containing valuable data.

IMPERIAL BRASS MFG. CO.

CHICAGO, ILL.

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Welding Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.

ACETYLENE CYLINDERS
Janney-Steinmetz Co.

ACETYLENE GENERATORS
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
The Harris Calorific Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

ALUMINUM FILLER RODS
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Mach. Co.
United States Welding Co.
Universal Oxygen Co.

ALUMINUM FLUX
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

ALUMINUM SOLDER
So. Luminum Mfg. & Eng. Co.

ANNEALING FURNACES
Buffalo Dental Mfg. Co.
Universal Oxygen Co.

APRONS (Asbestos)

ASBESTOS GLOVES
Mikesell Bros. Co.

ASBESTOS SHEET PAPER
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Mikesell Bros. Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

BLOW TORCHES (Acetylene)
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
The Alexander Milburn Co.
The Prest-O-Lite Co.

BOOKS (Relating to Welding)
The Welding Engineer

BRASS AND BRONZE FLUX
American Welding Co.
American Oxygen Co.
Hauck Mfg. Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
United States Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

BRASS SPELTER WIRE
American Oxygen Co.
Indiana Oxygen Co.
Universal Oxygen Co.

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Hauck Mfg. Co.
Superior Oxy-Acetylene Machine Co.

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Hauck Mfg. Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

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CARBIDE (Calcium)
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Union Carbide Sales Co.
Canada Carbide Sales Co.

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American Oxygen Co.
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Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
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Ideal Bronze Co.
General Welding & Equipment Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Messer & Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
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Superior Oxy-Acetylene Mach. Co.
Universal Oxygen Co.

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American Oxygen Co.
Bermo Welding Apparatus Co.
Bierman-Everett Fdy. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

CRANES (Portable)
Squire-Cogswell Co.

ELECTRIC ARC WELDING OUTFITS
Westinghouse Electric & Mfg. Co.
General Electric Co.

ELECTROLYTIC OXYGEN PLANTS
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American Welding Co.
American Oxygen Co.
Bierman-Everett Fdy. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
United States Welding Co.
The Prest-O-Lite Co.

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American Oxygen Co.
Bierman-Everett Fdy. Co.
Indiana Oxygen Co.
Apex Steel Corporation.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

FILLER RODS (Tobin Bronze)
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Bermo Welding Apparatus Co.
Bierman-Everett Fdy. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

FILLER RODS (Vanadium Steel)
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Bierman-Everett Fdy. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

FIREPROOF PLASTIC
Bermo Welding Apparatus Co.

FLUX WELDERS (Electric)
Westinghouse Electric & Mfg. Co.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
Universal Oxygen Co.

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Hauck Mfg. Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.

GAS BURNERS (Preheating)
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.

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United States Welding Co.

GLOVES (Welders Asbestos)
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Universal Oxygen Co.

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K-G Welding & Cutting Co.
Hauck Mfg. Co.
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Universal Oxygen Co.

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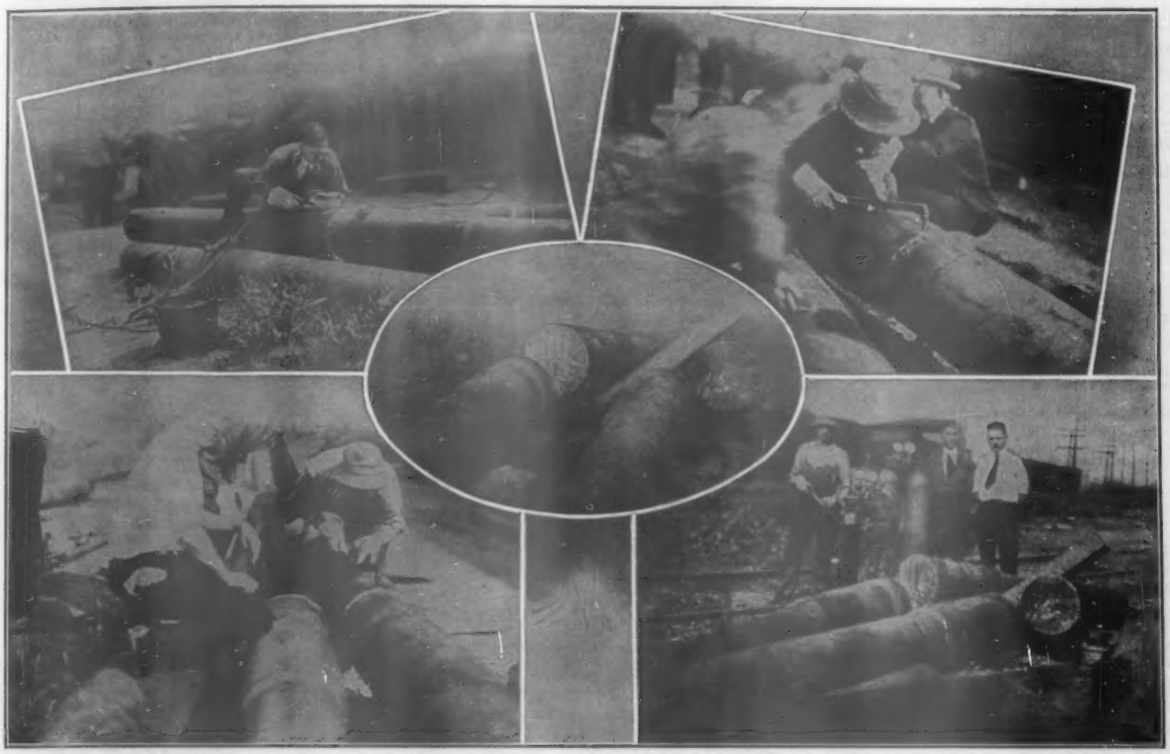
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

Cutting 14½" 15½" 16½" Shafting

With a Davis-Bournonville Oxy-Acetylene Torch



14½ in. Time, 17 minutes. 15½ in. Time, 12 minutes.
Cut with Davis-Bournonville Oxy-Acetylene Torch.
16½ in. Time, 16 minutes. After the cutting.

Since the introduction of the Oxy-Acetylene process of welding and cutting ten years ago, Davis-Bournonville apparatus has been the standard of efficiency and for comparison of less efficient apparatus.

During that time the apparatus has been continuously improved in advance of and in anticipation of more extended application of the Oxy-Acetylene process to all metal working lines.

Davis-Bournonville apparatus is employed extensively by the largest industries in the United States and Canada, for welding in the manufacture of metal products and on repair work, and for steel cutting and reclamation in foundries, steel mills, shipbuilding and navy yards, railroad and locomotive shops, and in the scrap yards.

Davis Apparatus Leads the World
In Range, Efficiency, and Apparatus in Successful Use

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Superior Oxy-Acetylene Mach. Co.

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Indiana Oxygen Co.
Logansport Oxygen Co.
Ohio Electrolytic Oxygen Co.
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Swift & Co.
Universal Oxygen Co.

OXYGEN CYLINDERS
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Indiana Oxygen Co.
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Indiana Oxygen Co.
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Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co., Inc.
United States Welding Co.
Universal Oxygen Co.

REGULATING VALVES (Hydrogen)
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
The Bastian-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
The Prest-O-Lite Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

REGULATING VALVES (Oxygen)
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American Welding Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
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United States Welding Co.
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THERMIT WELDING
Goldschmidt-Thermit Co.

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The Bishop-Babcock-Becker Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.

TORCHES (Oxy-Acetylene Cutting)
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American Oxygen Co.
Indiana Oxygen Co.
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Ideal Bronze Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Messer & Co.
Welding Supply Co.
K-G Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

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American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Ideal Bronze Co.
General Welding & Eq. Co.
The Harris Calorific Co.
Messer & Co.
Welding Supply Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
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The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Cutting)
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American Oxygen Co.
Indiana Oxygen Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Messer & Co.
Welding Supply Co.
General Welding & Eq. Co.
Ideal Bronze Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Vulcan Process Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Welding)
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Bermo Welding Apparatus Co.
Messer & Co.
Welding Supply Co.
Ideal Bronze Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Vulcan Process Co.
General Welding & Eq. Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
The Alexander Milburn Co.
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United States Welding Co.
Universal Oxygen Co.

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The Bishop-Babcock-Becker Co.
The Harris Calorific Co.
Superior Oxy-Acetylene Machine Co.

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American Oxygen Co.
Indiana Oxygen Co.
Davis-Burnonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

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American Oxygen Co.
Indiana Oxygen Co.
The Bastian-Blessing Co.
International Oxygen Co.
Universal Oxygen Co.

WELDING (Electric Resistance-Custom Work)
Thomson Electric Welding Co.

WELDERS' GOGGLES
William C. Adams.
Chicago Eye Shield Co.
Fidelity Brass Mfg. Co.

WELDING (Oxygen for)
American Oxygen Co.
Indiana Oxygen Co.
International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

WELDING RODS
Bierman-Everett Fdy. Co.

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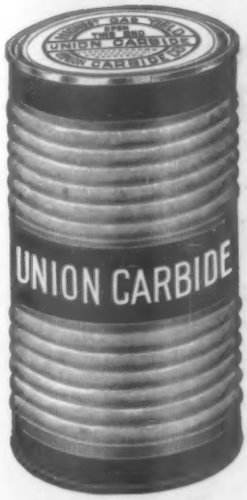

Packed in Blue and Gray Drums

Union Carbide Sales Company

New York City, 42nd St. Building | **Chicago, Ill., Peoples Gas Building** | **San Francisco, Cal., Kohl Building**

SOLE DISTRIBUTORS OF

UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

"Union Carbide" is packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

The following sizes are carried in stock in 100-lb. drums:

$3\frac{1}{2}$ x 2 in. —a large size.

2 x $\frac{1}{2}$ in. —a medium size.

$1\frac{1}{4}$ x $\frac{3}{8}$ in. —an intermediate size.

$\frac{1}{4}$ x 1/12 in. —finely crushed size.

Union Carbide in the Generator sizes above listed will be shipped direct to consumers from a **Union Carbide Sales Co.** warehouse at any one of the following points where large stocks are kept on hand:

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Mobile—262-268 S. Water St.
Montgomery—114 N. Perry St.
ARIZONA
Phoenix—42 S. Central Ave.
ARKANSAS
Fort Smith—109-123 So. Ninth St.
CALIFORNIA
Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
CONNECTICUT
Hartford—877 Main St.
DISTRICT OF COLUMBIA
Washington—Maryland Ave. and 9th St., S. W.
FLORIDA
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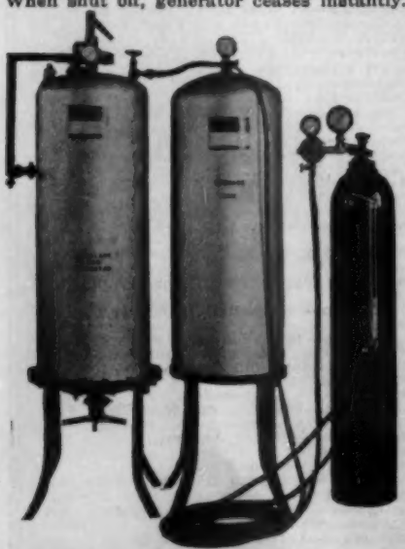

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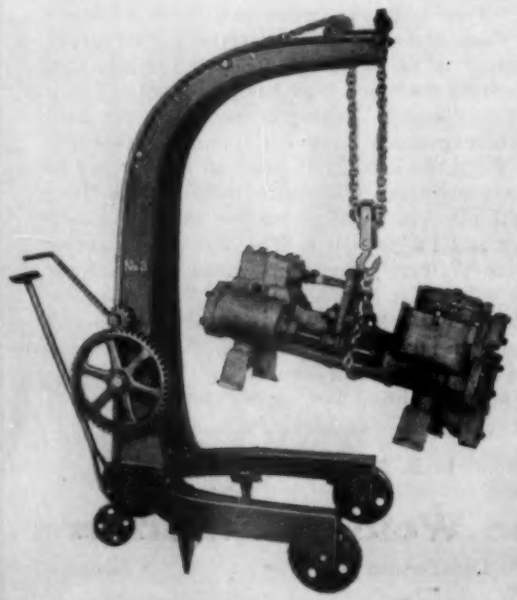

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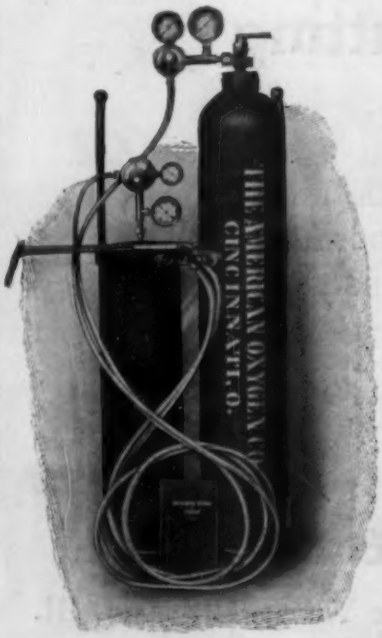

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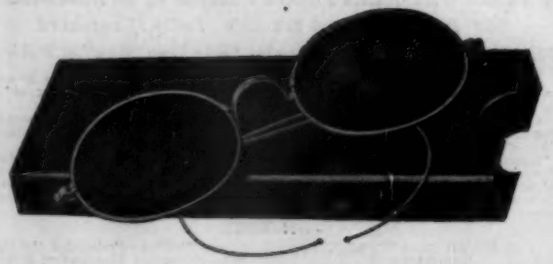

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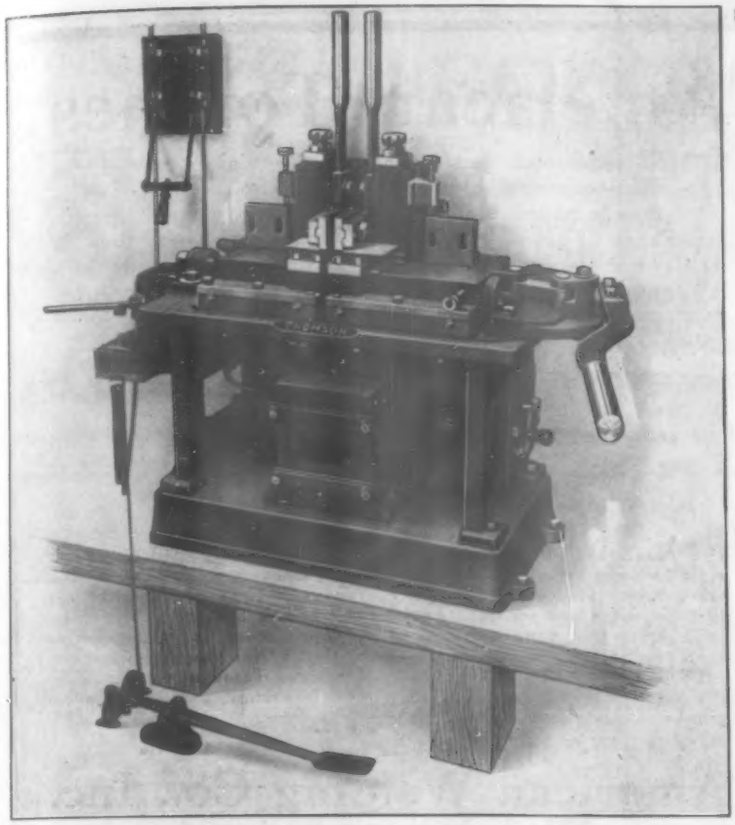

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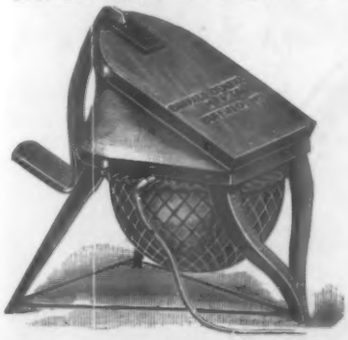

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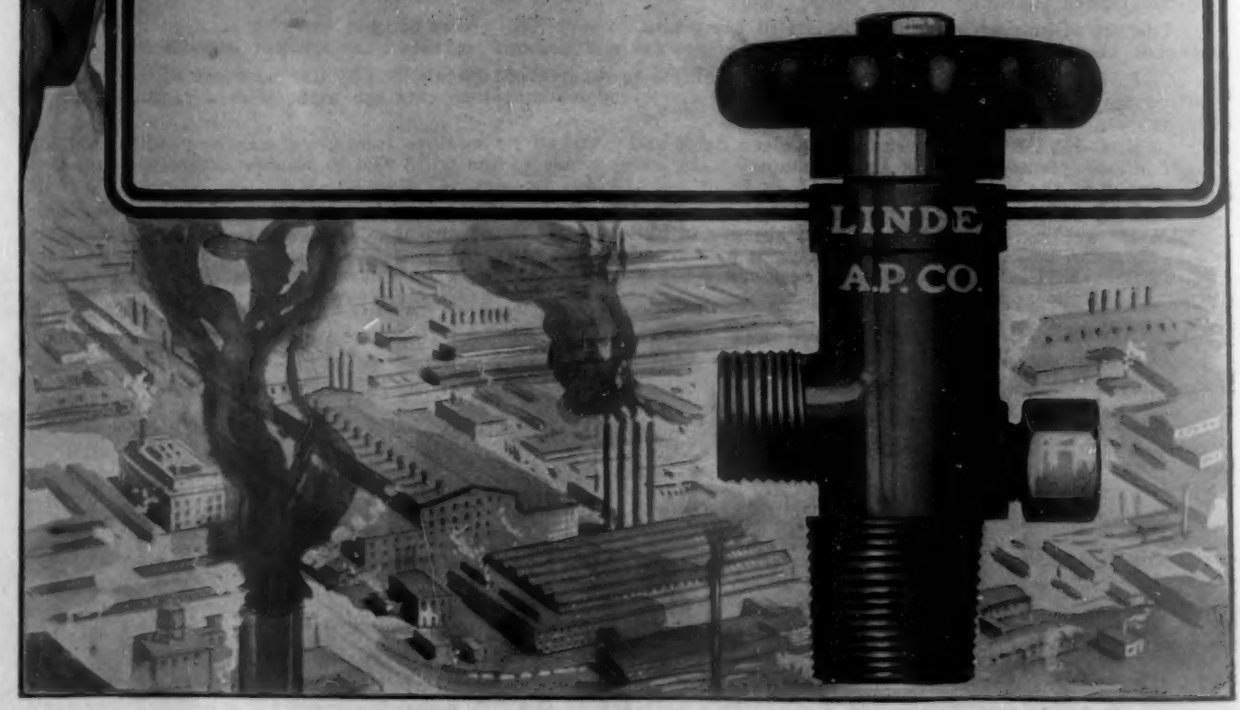

WELDING *and* CUTTING *with* OXYGEN *and* ACETYLENE

2—Principles of Cast Iron Welding

By M. Keith Dunham

PRIOR to the inception of acetylene welding, cast iron resisted practically all attempts to repair it. Brazing was limitedly used but due to the uncertainty of the bonding material actually going through the entire thickness of the break and the fact that the workman was so to speak "working in the dark" with reference to the bond being made, the process did not make any real growth.

While the training of the worker in metals before the introduction of acetylene welding had been that cast iron was practically impossible to repair, it is by all means the easiest of metals to weld with the acetylene flame if attention is paid to requirements not at all difficult to understand and execute. *A cast iron weld may be stronger than the original metal.*

Soft and Hard Iron.

The casting in general use is known as grey cast iron. It contains from three to five per cent carbon, is quite soft and easily machined. In a molten state it becomes very fluid and midway between this fluid condition and its solidifying one in cooling, it has the appearance and about the same strength as

Fig. 1. Edges Ground to 45° Angle.

wet granulated sugar. It is not a ductile metal—that is, it will not bend easily but will break sharply under a shock.

In a molten state, the carbon is combined with the iron. Upon cooling, the carbon should be distributed, or at least most of it should, in flakes. If the iron is cooled quickly, the carbon remains in a combined state and does not become distributed and the iron then is not soft and grey but hard and white. On the other hand, if it is cooled very slowly and the proper welding rod and flux are used, the carbon is distributed throughout the iron in the flake, or as it is called, graphitic state, and the weld is soft and workable. *Slow cooling then is essential to soft welds* and we must further use a welding rod which will help the distribution of the carbon in a graphitic state, since the formation of white iron rather than grey, is to be avoided.

The Welding Rod.

The successful welding of cast iron depends greatly upon the quality of the rod used as the filler. In the early days of acetylene welding, the importance of this was not recognized, and hard brittle welds which could not be machined and which broke easily were the rule. It has been found that silicon is the necessary element to propagate the formation of graphitic carbon; and this element is introduced into the welding rod. Manganese opposes the formation of graphitic carbon; necessarily the amount of manganese should be very small.

Fortunately the user of the acetylene flame is able to purchase a cast iron welding rod meeting these requirements at reasonable prices. On the other hand, it is also quite easy to purchase cast iron welding rods lacking the necessary amount of silicon but in appearance the same as the proper rod. It is wholly impossible to secure a soft weld unless a welding rod with the proper percentage of silicon and with a very low percentage of manganese is used. The rod should be free from sand and as long as possible. The diameter will depend upon the class of work done and the ordinary shop will find it desirable to have on hand at least three sizes and perhaps four. They may usually be obtained in sizes varying from ⅛ to 5/16—the former suitable for a weld on a typewriter part for instance and the latter for thicknesses up to three or four inches. For very heavy welds of several inches, it is desirable to weld two or three rods together and as well lengthen them out by welding end to end to avoid the necessity of bringing the hand in too close contact with the heat arising from a heavy weld.

Oxidation and Decarbonization-Fluxes.

Cast iron melts at about 2,200° F. The combination of oxygen and iron, called iron oxide, melts at about 2,450° F. As the

Fig. 2. Saving in Gas and Material By Beveling from Both Sides.

melting point of the oxide is higher than that of the metal and as the incorporation of oxide in a weld is detrimental, it is necessary that the flux employed destroy this oxide when formed or float it to the top of the weld, as far as possible forming a protecting film over the molten metal; and since decarbonization cannot be wholly prevented, it should also have the power to partially replace in the metal some of the carbon which is burned out. To a greater or less extent it should prevent the vaporizing of the silicon in the welding rod as well. It must of course aid in flowing the metal, that is, in bringing it to a more fluid condition. Various combinations may be used. Borax is many times employed and while it brings the metal to a fluid and is to some extent a cleansing agent, it does not have the property of preventing decarbonization, and its use is extremely likely to cause hard spots in the weld and leave a hard, glassy surface. Probably the most desirable fluxes have for their bases the carbonates of soda. As previously mentioned, the proper manufacture of fluxes should be left in the hands of specialists and as cast iron flux is very inexpensive, there is no reason why the user should attempt its manufacture.

Preparation of the Weld.

To insure a true bond through the entire thickness of the metal and to maintain softness by replacing the old metal of the break with new metal from the welding rod, it is necessary to

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bevel or grind the edges of the break. Scarfing or champfering are terms sometimes employed to describe this. A 60° angle may in many instances be wide enough, though many users of the process of acetylene welding prefer a wider one, say a 90°. If the latter angle, each piece, if entirely broken, would be ground on a 45°. (Figure 1.) It is to be remembered that in the welding operation the sides are amalgamated with the welding rod, and to properly do this, they are melted down towards the bottom; consequently too wide an angle results in increased time and cost for doing the work; yet it is important that the angle be of sufficient degree to insure a good amount of the new material from the welding rod becoming a part of the casting, so

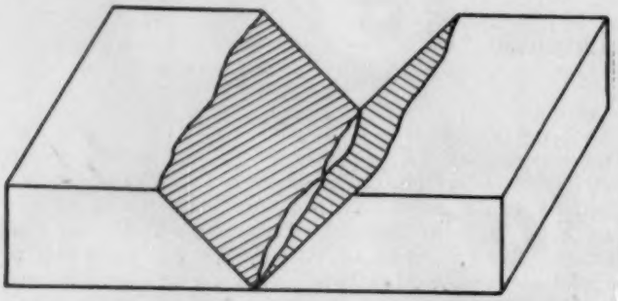

Fig. 3. Portion of Broken Pieces Left for Alignment.

that the silicon in the rod will aid in maintaining the softness of the welded section.

Beveling or champfering is of the utmost importance. A true weld is better assured, as penetration through the entire thickness is certain and moreover removes from the line of welding the old metal, which if remelted would become hard. Welders not familiar with the fact that as cast iron is melted it hardens, are prone to depend upon the velocity of the welding flame to melt down into the break and then scrape out the old metal with the welding rod. Aside from the difficulty of scraping out all the old metal, dirt and oxide in this manner to insure freedom from hard spots, this method invites lack of fusion as it is next to impossible for the operator to determine whether he has fused all parts. It may be concluded that even on very

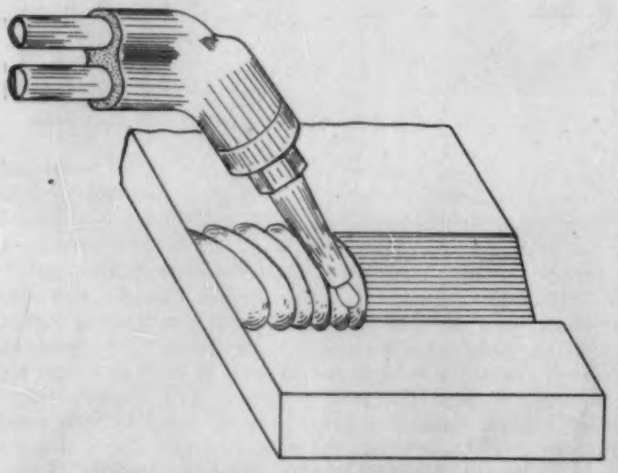

Fig. 4. Position of Flame to Take Full Advantage of Heat.

thin castings, it is advisable to grind out the break and that time so spent is well spent.

Depending upon the size, shape and location of the break, the means to do this scarfing will vary. A water jacket on an auto cylinder may be beveled by a diamond point chisel. A heavy crack may be chipped out by an air tool or if broken through, a portable or stationary grinder may be employed. On some pieces, it may be advisable to hack-saw the break.

For a short distance each side of the break, after the bevel is done, the metal should be cleaned before welding is start to avoid the possibility of incorporating this dirt in the line welding.

The break may not always be beveled from one side alo On pieces which may be moved easily while welding, it may ground out from both sides and this method is considera more economical, requiring less filler or welding material, may be understood by reference to Figure 2. *On pieces diffic to move while welding or where the alignment may be jeopa dized by moving, beveling is done from one side only,* it bein better economy in this instance to use more gas and weldin rods, as may be readily understood.

In order to secure proper alignment it is usually necessary to leave some portion of the original material when making the bevel so that the parts may be properly fitted together. This will be more readily understood by reference to Figure 3.

Position of Flame.

To take full advantage of the heat of the envelope of the flame, as well as of the cone, the ideal position of the welding torch in relation to the article being welded would be as shown in Figure 4. It will be noted that the weld is being made away from the operator and the torch held in line with the break. In practice, however, the heat arising from the channel or bevel many times prohibits this position, and it is necessary to work at right angles with the bevel as shown in Figure 5. If this is

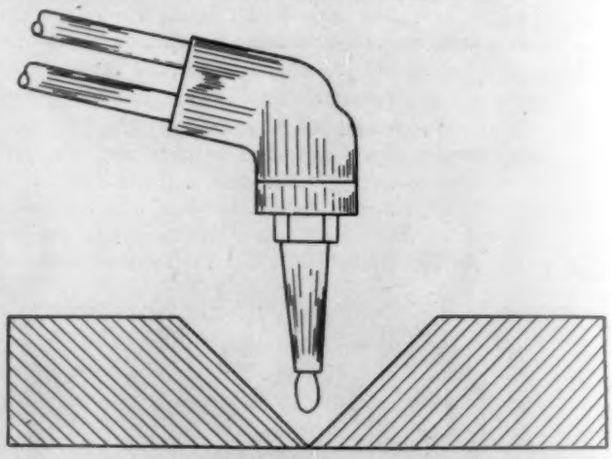

Fig. 5. Usual Position of Torch in Cast Iron Welding.

the position chosen, care should be exercised that the flame heats both sides and the work should be so arranged that the operator will weld in a comfortable position, holding the torch in a natural manner, and yet be able to secure fusion on both sides of the break and not as shown in Figure 6 where the flame is playing on the side of the break further away from him, a common fault of inexperienced welders.

The cone of the flame should not at any time touch the material; rather the end should be some little distance away from the surface of the material, and the metal brought into fusion without the cone coming into direct contact; this for the reason that hard spots in the line of welding will result and the weld made brittle.

The choice of the proper tip size is not a matter of such importance with cast iron as it is with steel, due to the fact that the cone does not touch the metal and the heating is more easily controlled by lifting the flame away or by making a wider zone of fusion if the flame is too large for the thickness of metal.

Manipulation of Flame.

As the bottom of the break comes to a bright red heat the welding rod is dipped into the flux and a small quantity picked up and brought down to the section which the flame is heating. The cone should not come into direct contact with the rod but should be held slightly away from it, the same as with the metal

being welded. At this point of the operation it is sometimes necessary to use the rod as a scraper to break the film which is on the surface of the bevel. The bottom is melted together and without adding any considerable metal from the rod the sides of the break are melted down and fused into the bottom part of the weld, together with some material from the rod, as outlined in Figure 7. This method is pursued until the original break has been completely filled and the weld built up or overcharged as shown in Figure 8.

The operator must use considerable care in bringing all sections into fusion. One of the common errors of the beginner is to add the metal from the welding rod to the casting while the casting is still at a red heat and not at a melting one. This

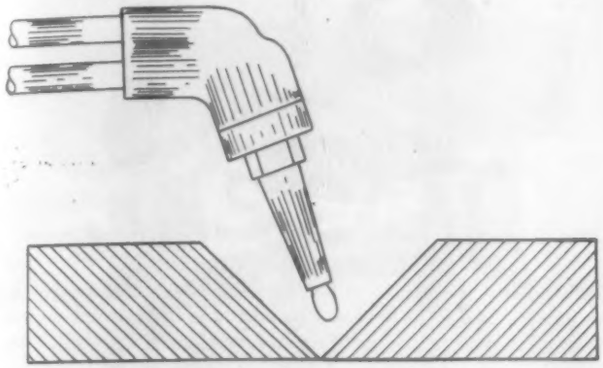

Fig. 6. Danger of Welding One Side Only By This Position.

method results in a "cold-short," and a weak bond naturally results. *Too much emphasis cannot be placed upon the importance of impressing upon the mind of the operator that acetylene welding is a fusion process, and that parts must be melting to insure a true weld.*

Sometimes a depression appears in the line of welding and the metal will not adhere. This is caused by some foreign material being present at this point—it may be dirt, but usually is sand which becomes incandescent under the flame. The welding rod is used to scrape this material out of the way and by holding the flame on that section and with the use of the flux, it may be removed and the metal will then fuse in that spot. It should never be passed over as it will weaken the bond and will show up in the finished weld in the shape of a hole.

Prevention of Warpage or Fracture.

In the previous issue we outlined four methods of overcoming the ill effects of expansion and contraction. Two of these are applicable to cast iron. One of the other two methods is not possible, that is the bending of the material, due to the fact that cast iron is not a ductile metal; and the other one, which is the use of water to prevent expansion, should never be used with cast iron for reasons which are evident when the character of the metal is understood. It will be remembered that cast iron must be cooled slowly to insure the proper distribution of graphitic carbon. The use of water prevents this, and while welders some-

Fig. 7. (Left) Sides Melted Down with Some Material from Rod. Fig. 8 (Right). Weld Made Thicker than Original Metal.

times use water or wet waste to prevent expansion, it may readily be seen that at the point where the metal is chilled there will be a section which is brittle and therefore likely to break under a slight shock.

The two methods, practical in cast iron welding, of taking care of expansion and contraction are the heating of the whole article or the heating of a section, and with cast iron this heating should always be done on at least that portion of the article in the vicinity of the weld for reasons already understood.

This heating may be done by various methods, the proper choice of which will depend upon the article and the shop equipment of the user of the acetylene flame. Charcoal is more widely used than other methods, but in our opinion gas and oil torches may be very profitably employed on many classes of cast iron welding, particularly where only a section of the article must be preheated.

To understand the necessity for watching out for expansion and contraction let us illustrate by a bar broken in the center and put upon the welding table after the V has been made and the two parts fitted together. The weld is made and the bar allowed to cool. If careful measurements are taken it will be found that the bar is slightly shorter than it was before it was welded. *Cold-metal must occupy a smaller space than hot metal,* and in cooling the bar shortens somewhat due to the fact that the ends of the bar do not move while the weld is being made. *Expansion takes place the easiest way,* and it is far easier for the hot metal to creep or expand together than it is to push the ends of the bar outward. In making a weld of this character it is necessary, then, to slightly separate the edges of the break before starting to weld to allow for this shrinkage.

Now assume that this bar is a spoke on a wheel as illustrated in Figure 9. Here one end of the bar is attached to the rim and the other end to the hub. If we make the weld without thought of contraction, the spoke will break in contracting or the rim will be warped or broken, depending upon the construc-

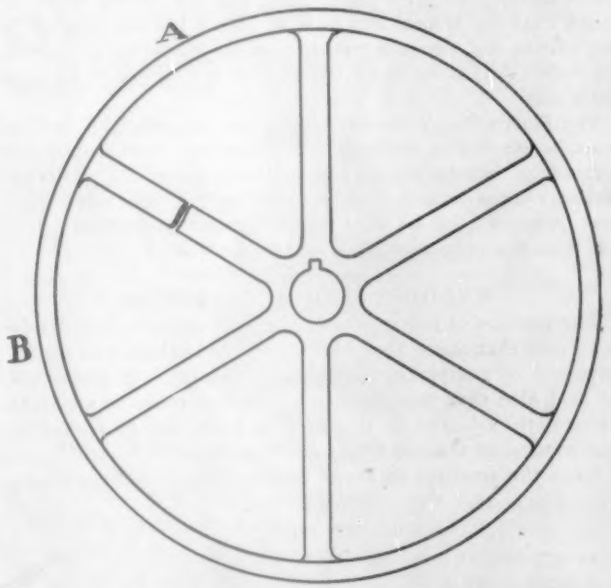

Fig. 9. Heating Rim to Draw Open Break.

tion of the wheel. It is possible in a job like this to heat the whole wheel to a red heat, make the weld and allow the wheel to cool, but this is not practical as the hub is of considerably heavier construction than the spokes and the rim, and to heat all parts evenly would be extremely difficult and in this instance unnecessary. Remembering that we want to separate the edges of the break slightly so that in the cooling of the welded area the spoke or bar contracts to its original length, we may heat the rim at points A and B slightly, and the expansion of the rim, as may readily be seen, will separate the break in the spoke as we want it. The weld is then made and the rim and the spoke cool and shrink to the desired point.

Note Figure 10, a casting with two arms projecting, the ends of which are bored to receive a shaft. One of these arms is broken. A natural thing for the beginner to do is to insert a bar with the idea that this will hold the piece in alignment with the other arm while the weld is being made. If this course is pursued, it will be seen that as the metal cools the arm shrinks

and pulls the bar toward the weld, and if the casting is used in this condition, the shaft cannot be in absolute alignment, and a fracture of one of the arms is bound to occur, though not necessarily of the welded arm. To successfully weld a job of this character, the bar may be inserted if desired, and the arm which is not broken may be heated in one section to a red heat. The metal expanding will separate the edges of the break, the weld may be made, and both arms will contract equally. Heating only the arm which is broken will not prevent this distortion. If we

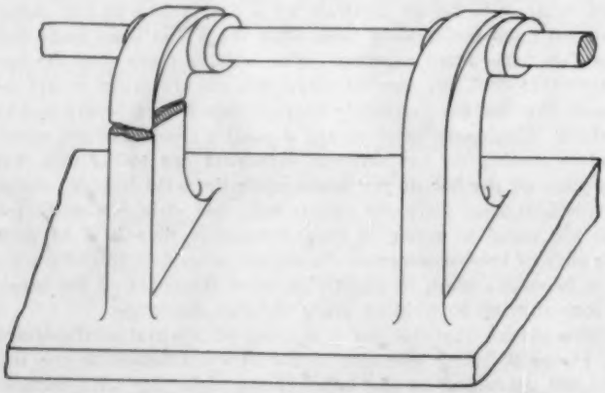

Fig. 10. A Job Like This is Often Incorrectly Handled.

could correctly estimate the shrinkage of the cooling metal we could treat the broken arm as if it were a bar not attached to any casting and separate the edges of the break before starting the weld. And if we had duplicate jobs this method is perfectly practical.

The illustrations given are simple but the principles outlined must be studied in order to understand the more complicated contraction effects which will be later described. A repair welder must constantly bear in mind at least one rule: Each time he plans a job he must take this into consideration: *Cold metal must occupy a smaller space than hot metal.*

WELDING SHOP ACCESSORIES

The process of joining metals by heat without compression is so new that many shops have not yet awakened to the importance of equipping with aids to welding. It might well be said also that many manufacturers of tools or apparatus particularly adapted to the welding trade fail to realize the importance of the welding trade market.

Even the smallest of shops requires some of these aids to welding. Repair work, particularly, demands nicely finished welds and increasing competition means that shops must equip to prepare work properly and as economically as possible carry out the welding.

Of course all shops realize the essentials of successful welding—the quality of apparatus; rods and fluxes, table, goggles, etc. But how many shops are equipped with that tool as shown in Figures 1 and 2, a portable grinder? And how many others are using grinders wholly unsuited to the rough treatment the grinder in the welding shop receives? It is physically impossible to finish any but light work on a stationary grinder and even light work is difficult to handle to secure an even surface; in other words a portable grinder

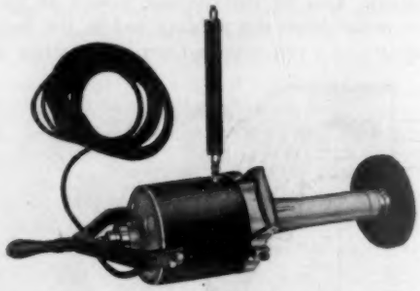

Fig. 2. Portable Electric Grinders Are Made in Various Styles.

is a necessity if work is to be delivered which looks right on the outside and it is needless to add that appearance counts for a great deal in the welding industry, as it does in all industries.

The stationary grinder is of course an absolute necessity in every welding shop, but its use may be more properly described as one of preparation rather than of finishing.

Another form of grinder is that shown in Figure 3, the wheel being connected to the motor by means of a flexible shaft and the power to drive it is obtained from the source in use for other shop purposes. One of these two types, or perhaps both, is essential in every welding shop and the uses are innumerable.

The job shop handling all kinds of repair work will find a pneumatic or electric chisel as shown in Figures 5 and 6 a time and money saver, particularly on heavy castings where the break must be beveled out to a depth of several inches. Such a tool makes quick work of a job which is extremely laborious with the hammer and chisel and the good right arm.

Chain hoists must be a part of the shop equipment of every shop handling general repair work. They are made in many styles and are of varying lifting capacities. Turning a large casting while it is being welded is practically impossible by any other means. If the job shop handles particularly heavy work, it may be advisable to have a crane as well and even in small shops a portable crane hoist as shown in Figure 7 is a paying investment, particularly in those shops doing

Fig. 1. One Type of Portable Electric Grinder.

Fig. 3. Flexible Shaft Driven Portable Grinder.

automobile repair work where it is so many times of value in lifting the motor out of the frame or holding up the rear end of the chassis to take out the rear housing.

The use of gas and oil torches is of course daily becoming much wider. Charcoal for preheating is excellent but in many instances gas or oil torches mean quicker work and therefore a more economical weld and less liability of warpage or fracture and for outside work, oil torches are of course indispensable.

In using gas, the air supply should properly come from a positive pressure blower, as the pressure required is only two or three pounds and tapping the compressed air line, while many times done, is rather costly particularly as the positive

Fig. 4 . Gas Furnace for Heat Treatment.

pressure blower is quite inexpensive to purchase and operates very economically.

It is becoming an axiom in the welding industry that proper heating of castings is more important than the welding itself. In every other industry when a slow, even heat is necessary, a furnace is constructed to operate with gas or oil and some welding shops have already given this subject considerable study with the result that for many classes of work they have found it economical to have constructed a permanent furnace for preheating along the lines of Figure 6. The positive pressure blower used to operate the preheating gas torches gives the necessary volume and pressure of air and either natural or city gas is used.

A pyrometer to indicate the temperature of the oven may be profitably added in many instances. With the combination of a proper gas furnace and a pyrometer, guess work is

Fig. 5. Pneumatic Chisel for Beveling. Also Made in Electric.

eliminated. If the temperature desired is 800° for instance, the pyrometer tells us when the oven is at that heat and it is unnecessary to guess at the heat, as is at present the common method of ascertaining temperature in the welding shop.

Grinding wheels of various diameters are of course in common use and manufacturers of wheels particularly adapted to welding work are beginning to pay some attention to the market. Every welder knows the difficulty of grinding aluminum with the ordinary wheel, which quickly gums up. A few years ago we saw one shop equipped with a steel wheel. Whether this has been placed on the market we cannot say, but we can testify to the remarkable grinding qualities of it and know that no welding shop would be without it after they had once used it.

Portable drills are usually a part of the welding shop equipment for redrilling holes which have to be filled up when they are in the line of welding and a stationary drill of simple, rugged design, with no fancy attachments, may usually be found in even the smallest shops.

Particularly when automobile repair work is made a specialty, it would seem that the success of the shop to a large extent depends upon the proper finishing of the work. Besides those tools already enumerated, a lathe and a planer

Fig. 6. Heavy Castings Can Be Beveled Much Quicker with Power Driven Tools.

are essential if crank shafts and aluminum cases, as examples, are to go back to the owner ready to use.

The lathe should be a fairly good size one, even for the small shop and it is better to err on having too much swing than too little. Probably one with a 24 to 30 inch swing and 6 to 8 feet between centres would meet the requirements of most shops.

The planer should be bought with the same ideas in mind. Speed is not essential with either the lathe or planer, since

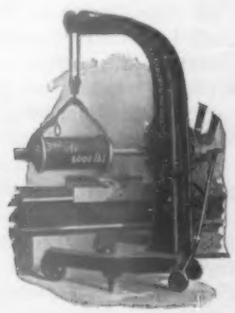

Fig. 7. Portable Crane. More Efficient Than Chain Hoists.

the problem is not a manufacturing, one and attachments which bring up the initial cost may be avoided.

There are of course many other accessories which the welding shop may with profit purchase. These accessories may perhaps be more properly called machine tool equipment.

In a competitive test of a number of welding outfits held by the Northern Pacific Railroad at the Brainerd, Minn., shops, the test employed was to weld a fire door in a locomotive. The circular plate welded in was 10 ft. 2 in. in circumference. The winning outfit, the Vulcan, made by the Vulcan Process Co., Minneapolis, Minn., completed the job in eight hours and twenty minutes. Winning this test resulted in the N. P. adopting the Vulcan as its standard welding and cutting equipment. Since installing the Vulcan a set of broken drive wheels have been repaired by welding the spokes to the hubs. These wheels are now in use and in perfect condition.

Jack Harding, Promotor of Sales, Prest-O-Lite Co., has been elected vice-president of the Russel M. Seeds Co., Indianapolis. This company is in charge of the Prest-O-Lite advertising campaign. This makes the Seeds Co. one of the most important concerns of the kind in the West.

REMINISCENCES *of a* WELDER

V—The Man Who Wouldn't Learn

IN the reminiscence previous to this one, I spoke about the general knowledge of things metallurgical, which is obtained by the job welder. This applies as a rule. There are exceptions, of course, as there are, so they say, to all rules and this is a story of one of the exceptions. The thoughts of the earlier days bring to mind many of the lighter happenings in the shop which helped to cheer us along through our little tragedies of failures. And they brought to mind some memories of one particular old time welder. He's out of the game now; in fact, he never was really it in, just sort of hung around on the outskirts, so to speak. He never took advantage of the other fellow's mistakes nor in fact of his own. And knowing him so well, I hardly believe he'd read a trade paper, so the chances are he won't read this. A good many old timers in the East will recognize him and if by chance he does read this, I just want to square myself in advance by saying that while some of us have had many good laughs at his mistakes, we all liked him. We didn't laugh at him; only at what he did. He was one of the few job welders I have met who simply wouldn't, or couldn't, learn. We'll call him Bill.

Interrupting the story of Bill for a moment, I wonder why all the "bugs" eventually tell their discoveries to the job welder. In my time I reckon I've listened, more or less patiently, to all industrial revolutionizers. Steel automobile tires, apparatus for perfect kerosene combustion, aeroplanes which couldn't fall, autos propelled by carbonic gas or compressed air, gas-hot water heaters to put the coal barons out of business—I've had my share in helping build these and hundreds of other devices which were to set the world afire. But one particular invention I wish I knew the end of. The inventor of this was a typical "bug." Short in stature, long hair, a huge drooping mustache and bushy eyebrows, he was an ideal moving picture hero for a Nihilst bomb plot. To complete the painting, he carried an old black bag. Cautiously he inquired for the proprietor. Upon being told he was talking with him, he discreetly opened the bag and took out a device made of two flat aluminum bars, on each of which was an iron piece which slid back and forth. Could we shorten these bars one-quarter of an inch exactly. We thought we could. Well, there were sixteen of them and he was anxious to get them as soon as possible. Telling him to leave them and call the next day and they would be ready, he replied that it was impossible, that he must stay with them while they were being welded, as spies were constantly following him to find out his secret. Realizing that I had a real "nut" to contend with, and having lots of work to do, I called for the foreman and told the inventor that the foreman would personally weld them. Standing on his tiptoes to reach my ear (I was at least a foot taller than he) he whispered stagily that these pieces were the equalizers of his perpetual motion machine and that it was completed, everything ready except the shortening of the equalizers. This was one of the occasions when I was glad I was the boss; for the foreman had to listen for a matter of two or three hours to a long dissertation on that perpetual motion machine.

Reverting now to Bill whose ideas of the welding industry were (and still are, I think) on a par with the perpetual motion inventor. Bill's idea of welding was that the flame did all the thinking—all that was necessary was to own a welding outfit. Before welding was introduced into this country, Bill had had considerable experience in an industry closely allied with welding and he naturally gravitated into the job welding game. He worked for me two weeks and while I plead guilty to the fact that at that time my knowledge of welding was extremely limited, Bill's was a minus and after trying to tell him that it wasn't a good proposition to weld cast iron with steel and having Bill tell me that steel was considerably stronger and the weld would be sure to hold up if so made, we parted company and Bill opened up a job welding shop of his own.

His home was quite near our shop and he dropped in frequently on his way to and from his place. Taking advantage of his invitation to visit his shop, I went down to look his equipment over. Now, equipping a shop then was quite a bit costlier than it is now and Bill's equipment had cost him close to $3,000 and yet he had but one welding torch and that one wholly unsuitable for repair work, it being built for welding sheet metal and the limit of its work was about half-inch cast iron.

Other than being poorly equipped with the most important part of the job welding shop, his tools and appliances were very good. The day I happened to visit him there was lying on the floor a huge casting, a junk dealer's metal shears, which had broken in attempting to shear a piece of metal too large for them. The break was about sixteen inches through and abutted a shoulder about two feet thick. Now, jobs bigger than this have since been done with the oxy-acetylene flame, but at that time we classed them as impossible. That metal dealer had had those broken shears for some time and well do I remember our foreman talking on the telephone with him. Upon being informed that we could not weld them, he wanted to know from the foreman if we thought they could be cemented! But friend Bill was not afraid to tackle them with his little torch. Now, you readers have probably realized by this that Bill was the type of man who couldn't be reasoned with, so I just casually remarked upon the thickness of the casting and wondered how he was going to make the bevel. "Why," says Bill, "I'm going to take a cutting torch and cut the bevel from each side." Not daring to take issue with him over the practicability of cutting cast iron and yet not wanting him to waste his time on a job he couldn't do, I told him that getting that amount of metal hot enough to start welding would be a terrific job. Thereupon, Bill showed me eight pre-heating gas torches he had made from half-inch gas pipe. Lighting them all and turning on the blower he produced a long sickly looking flame without a sign of a blue cone and the total volume of heat emitted by the eight torches would have been just about right for a single cylinder from an automobile motor. I left him, knowing full well that he would tackle the job and some time later I saw the casting. After ascertaining that he couldn't cut the bevel with the cutting torch, he had actually started to fuse the break together on the surface. Finding that he could not do so, he had melted twenty or thirty pounds of welding rods on to the top, but in attempting to turn the casting over to do the same with the other side, the two pieces pulled apart and Bill gave the job up.

Some time after this, Bill came to the shop one night rather out of breath and stated that he wanted a real up-

to-date cutting torch. All we had was the regular welding torch with a copper tube attachment to the side, but this was not suitable for Bill who advised us that he had taken a contract on a big cutting job and wanted a real cutter. There was at that time only one cutter of the so-called concentric type, which was what Bill was after; so he telegraphed for it to Buffalo and brought it in, proudly showed it to us, and told us that he had us skinned and was going out and get all the cutting work in that section.

A few days passed and one evening, just as we were getting through work for the day and were talking over the things to do on the morrow, a very tired, smutty faced, disconsolate Bill showed up. Slumping down on a stool and by his very air commanding our silence and attention, he said: "Boys, I just want to advise you that you can't cut bronze. I've tried for three days and used twenty tanks of oxygen on some propellor blades and it can't be done, so don't waste your money trying." There was an attempt to keep straight faces for perhaps half a minute and then we all yelled, but Bill couldn't see the joke then, and I doubt whether he ever did. Shortly after this event, Bill gave up his job welding shop. I met him about six months ago and he wanted to know if I thought the oxy-acetylene business ever would amount to anything.

Here's the moral: READING ABOUT THE OTHER FELLOW'S EXPERIENCES MAY PREVENT THE OTHER FELLOW HAVING THE LAUGH.

Next Month—The last story of the series will be "Jottings From the Notebook."

BRAZING OF GALVANIZED SHEET IRON

By B. Kopferschmidt.

One of the greatest inconveniences in connection with the use of sheet iron and steel for general purposes, is the tendency of the metal to oxidize and rust in the air under ordinary atmospheric conditions.

Highly polished iron in contact with a solution of ordinary carbonate of soda, kept in dry air, will not rust.

Protective coatings of paints of various kinds, are generally applied to metals to prevent it from corrosion. The function of these is more mechanical then chemical; the coating simply preventing the metal from coming in contact with the oxidizing medium.

In certain cases the corrosion of iron can be diminished by placing a more active metal in contact with it, such as zinc, tin, copper and nickel.

In the case of zinc, a sort of permanent metallic paint coating is obtained, which coat acts as a preservative in the threefold manner; of a mechanically preventing contact with air, of galvanically confining the oxidation to the zinc, and of chemically causing the iron to be coated with a basic film of zinc oxide.

Thus when perfectly cleansed iron is immersed in melted zinc, and the latter adhering to the surface, it forms galvanized iron.

Galvanized iron cannot be welded successfully with the oxy-acetylene blowpipe, for two reasons. First, it burns the zinc and leaves an unprotected surface from oxidation at the welding line. Second, the zinc thus burned will incorporate in the weld and decrease the strength of the weld to a great extent. The first defect can be remedied (excluding the question of cost) by regalvanizing the article after welding, but in the second defect lies the chief weak point in welding galvanized iron, because it is impossible to free all the zinc from the iron, at the welding line.

However, the brazing process can be successfully applied in joining galvanized iron with the oxy-acetylene blowpipe. The brazing does not burn the zinc, but it incorporates with the brazing metal, which is a composition of copper and zinc. The brazing metal will melt more readily at the joining edges, and will spead on each side about ¼ inch. At the very end, where the brass stops from spreading, the zinc will continue as a protective coating agent, thus the brazing process leaves no surface unprotected, leaving the brazing line with a brass coating instead of zinc.

To braze galvanized iron, use a smaller welding head, as it would require for welding the same thickness. For a brazing compound on sheet metal, one may use the ordinary ⅛ inch brazing wire. For angle iron or heavier articles use 3/16 inch or ¼ inch tobin bronze rods.

The brazing of thin gauge galvanized iron does not require the same amount of care and skill as in welding thin sheets of iron. If one wishes to braze two plates of galvanized iron, he must overlap the edges about ⅛ inch, then the edges are tacked about every three inches. After this operation the whole line is brazed from one end to another. Although there is not so much heating as for the welding operation, yet the expansion will bring about a slight bending, but through hammering it is easy to bring the plates back to its original position.

If an increase in thickness at the brazing line is not desired, one may hammer the edges down to half its thickness, thus when overlapped ⅛ inch, the surface at the brazing line will be the same as that of the sheet.

The method of brazing is to heat the edges to be joined, and a little pulverized borax is sprinkled, then the brazing wire is melted and adheres to the edges to be joined, and the joining is obtained simply by cooling. A good brazing job is considered when the brazing metal runs throughout the lap and spreads a little on the opposite side.

On May, 1914, the writer was interested to substitute the soft soldering process on ice cans, with that of the brazing process. For that reason he had tested a few specimens of brazed galvanized iron plates at the Davis-Bournonville plant on their testing machine, with satisfactory results. On a pulling stress the metal never gave way at the brazed joint and the writer was satisfied that the brazing increased the resistance of the joint.

In order to protect thin iron plates from oxidation and to enable them to be readily soldered together so as to manufacture the numerous articles in ordinary use made by the tinsmith, they are coated over with a closely adherent layer of metallic tin, forming tin plate. Such tin plates should not be attempted to braze, because the heat will melt or burn off the tin that melts at 450 degrees Fahrenheit, and leave the molten tin on the surface in small drops. The soft soldering process, with a soldering iron is the practical method for joining such tin plates.

Other iron plates covered over with protective coatings of other metals, notably copper, brass and nickel, can be brazed the same as the zinc coated plates. If the brazed part that possess a different color than the coated metal is objectionable, one may cover the brazing line with an aluminum or other whitish paint so that the color may appear uniform.

The Burdett Oxygen Company will complete the erection of its Salt Lake City plant on March first, and will be in a position to furnish pure oxygen to users in that territory. This is one of a chain of plants erected by the Burdett Company. The capacity of their Los Angeles plant has recently been increased 50 per cent.

The Thomson Spot Welder Company, Cincinnati, Ohio, have issued five bulletins, Nos. 201 to 205 inclusive, covering a line of machines for spot welding sheet steel where the total thicknesses of the metals vary from ⅛ to 5/16 in. Each of the bulletins is practically the same in arrangement, engravings of the different machines of the particular type described being presented, with general description and specifications and views of the machines in use.

The Welding Engineer

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Copies to prospective advertisers	85
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Copies mailed as samples to prospective subscribers	1,498
Copies for office use	10
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A Month of Suspense.

THE past month has been one of grave and unusual concern in the political and business world, owing to the sudden development of the crisis with Germany. Diplomatic relations were severed under circumstances which seemed to make war inevitable, and although a month has passed without an act of direct hostility upon either side, the situation is no less critical than when the German Ambassador received his passports. The issue between the two governments is directly joined, and no longer under dicussion.

There is no reason to anticipate that a declaration of war by this country would have any immediate effect upon the business situation, other than that resulting from additional stimulus. The government has already entered the market for equipment and supplies, and is committed to great expenditures upon the army and navy, but doubtless its orders would be increased and expedited. The experience of other countries, and our own as well, shows that war makes enormous demands upon the industries, hence there would be no reason to apprehend a sudden reaction from the present activity. The danger would be from the other side, i. e., from an over-stimulus in certain directions at the expense of normal development. The industries of this country are already working to capacity, and it is difficult to see how they could do more. Under such conditions government orders would crowd private business to the rear, create new demands for labor and materials, and probably raise costs to a higher level. Enlistments would necessarily aggravate the scarcity of labor, and the amount of business in sight would be likely to stimulate further construction work for the enlargement of industries. These are the inevitable economic derangements caused by war, and in some degree we have already been experiencing their effects. War is not recommended by anyone who understands its economic effects as a means of increasing the wealth of the country, but if war must come it is certain that the United States is more fortunately situated to withstand it, and has greater resources with which to prosecute it than any of the countries which have sustained such marvelous exertions for now two and one-half years.

A Boost for Welding.

FROM an advertisement in a well known engineering paper we cull the following:

"It was up to somebody to show me why the specifications should call for riveted pipe, which was a third heavier than pipe I knew was fully as strong, and cheaper, to boot.

"Well, I found out that the rivet holes weakened the plate so much that the lap joint had to be one-third too heavy for the actual steel needed in the straightaway, and that's where the loss came in.

"Rivet holes don't hold an ounce of water—they only hold rivets."

Sounds like a welding advertisement, doesn't it? But it isn't—just some talk about a special rivetless construction. There are some talking points in this advertisement which are applicable to welding, however. Just why should engineers specify heavy, costly, riveted pipe, when welded pipe is smooth on the interior, thus reducing friction; can be of smaller gauge, because the weld may be as strong as the pipe, and can be absolutely tight?

Probably the only reason that welded pipe is not used to a larger extent is that its advantages have not been as strongly brought out as they should have been.

Other Than Commercially.

MOST of us think of welding and cutting apparatus as implements of trade only, entering into every avenue of the City of Metal. It bonds or cuts, and is being everywhere recognized as an essential unit in the scheme of industrial efficiency.

But how often do we think of the cutting torch as something bigger and with a nobler use than mere dollar making? We have noted lately a number of instances in New York City where this "knife of fire" has been successfully used to save human life. There seems to have been quite an epidemic of boys and men becoming wedged between elevators and girders, and in one rescue several men were pinned underneath an elevator in a collapsed garage. The New York City Fire Department, equipped with cutting torches, has been able to save human life in each case.

As our English cousins would put it: "It gives one a bit of a thrill" to realize that one is connected with an industry which is the means of life saving.

And coming down to the matter of fact and quite commercial aspect, it might be advisable and deemed good business to see that the fire department of your city is properly equipped with cutting apparatus. High steel buildings are not essentials to its use. Anywhere where there are elevators there may be some time urgent need for it, and estimating the value of a human life at $20,000 (which we believe is a figure sometimes set by those who love to deal in the statistical) the investment, from a purely commercial standpoint, is a high class one.

Welders For The Army.

FROM time to time we hear of the need of welders for the various armies abroad. Only recently England has commissioned one of her welding experts, Mr. D. Richardson, Editor of the Acetylene Journal, and we presume he is training welders. Should we have an occasion to put a large army in the field we shall need a vast number of skilled welders, both for service in the field and at home. Other industries are organizing and measuring their strength, it's high time the welding trade did something. This would be one more useful employment for a good welding association.

A MASTER WELDER'S RECORD

Accurate Records Should Be Available —System in Use on a Large Railroad

By B. Kopperschmidt

A Master Welder is measured by his ability to judge, plan and solve the different problems that arise in his shop. If his judgment is sound, then it is the result of exact knowledge of all factors involved in his trade. A decision may determine whether the job is weldable or not. If it is weldable the Master Welder must inform his men how the work should be done. If he lacks this knowledge he must guess.

The Master Welder, in dealing with his men, must know how to teach them the trade, to organize, classify and supervise.

The Master Welder must have a wide range of knowledge in the metal trade. He must know something about metallurgy, gas generation, the technique of metals, and the ability of performing the work he advocates. He is unlike the Master Machinist, a "working foreman," who walks down the shop with a piece of work and a file in his hand, filing as he goes. The Master Welder cannot employ graduate welders, as in the machinist trade. Therefore, in ninety cases out of one hundred he must organize and teach his own force, and until an ample supply of graduated welders will be avail-

OXY-ACETYLENE WELDING REPORT

MACHINE AND LOCOMOTIVE SHOP — MONTH OF - AUGUST - 1916

WELDING

ARTICLE WELDED	No. Operations	Actual Hours Welding or Cutting	Wages of Men for Total Hours	Cost of Gas and all Supplies	OTHER LABOR	TOTAL COST	OTHER METHOD	SAVING / *LOSS*
Air drums-welding test plates	10	.6	.95	1.86		2.81	3.55	.74
Air drums-welding holes, etc.	18	7.0	3.20	16.24		19.44	32.87	13.43
Air drums-welding heads	4	4.3	2.22	9.98		12.20	17.50	5.30
Driving Box	2	1.0	.40	2.32		2.72	2.55	.17
Equalizers	1	.8	.27	1.86		2.13	1.80	.33
FIREBOX WORK								
Welding up staybolt & Miscl holes in firebox sheets	396	31.0	34.13	118.32		152.45	475.74	323.29
Welding new sections to old sections of firebox sheets	19	67.0	57.07	155.44	170.10	382.61	226.64	*155.97*
Welding bad spots on firebox sheets	3	5.3	2.47	12.30		14.77	39.72	24.95
Welding patches on firebox sheets	16	18.3	8.84	42.46	48.27	99.57	118.42	18.85
Heating Flexible Staybolt caps to remove	55	1.7	1.09	3.94		5.03	43.20	38.17
Frames, Truck	1	1.3	.55	3.01		3.56	4.00	.44
Injector Elbows	10	2.3	.87	5.34		6.21	6.80	.59
Injector Front	6	2.3	1.13	5.34		6.47	52.58	46.11
Trailer Box	2	.6	.31	1.39		1.70	1.70	.00
Waist Sheet	2	2.3	.85	5.34		6.19	14.98	8.79
TOTAL	728	254.4	155.20	590.23	218.77	964.20	1598.71	791.68
							Loss Saving	*157.17* 634.51
CUTTING								
Cutting on Air Drums	1	.2	.19	.48		.67	1.15	.48
" Angle Iron	28	.7	.34	1.69		2.03	2.70	.67
" Ash Pans	8	2.0	1.42	4.82		6.24	13.62	7.38
" Miscel. Holes	230	6.7	4.39	16.16		20.54	28.75	8.21
" Miscellaneous	27	9.1	4.21	21.93		26.14	23.12	*3.02*
TOTAL	5879	91.1	52.51	219.55		272.06	360.91	92.26
							Loss Saving	3.41 $ 88.85

Fig. 3

able he must do actual work. Yet in addition he must devote his energies, like any other foreman, to the development of better methods in his department.

In the railroad shop a Master Welder usually has two welding methods, the acetylene and the electric. In this case he must have a thorough knowledge of the kind of problems which will constantly confront him, and also of the proper method of their solution. To do this accurately he must have correct monthly records, showing the cost of labor and material on each process for each individual job, the cost and maintenance of his equipment, the cost of gases and supplies, the average cost of cutting or welding blowpipe per hour, each month, the cost of the electric current in his shop per hour, etc. With such records on hand the Master Welder can determine, without guessing, which method is the most economical and successful for each individual job.

To begin this record one must have forms for the acetylene and electric welders' report, as in Figures 1 and 2. These reports must be partly filled out by the operator on each individual job, and, of course, inspected by the Master Welder for their accuracy. In case of a welding job the operator must fill out the amount of time charged, the amount in cubic feet of oxygen and acetylene, the amount of welding rods per foot, to which he signs his name. The rest of the information is filled out by the Master Welder. He must also know the standard weight of each size welding rod, so he can determine the proper weight of rods consumed on each job.

WELDERS REPORT

CHARGE ..... DATE ..... 191.....
JOB .....
OTHER METHODS .....

TIME CHG. TO JOB	OXYGEN CU. FT.	ACETYLENE CU. FT.	WELDING ROD FLUX	COST OF BLOW PIPE HOUR	OTHER COST	TOTAL COST	OTHER METHOD MAT'L	OTHER METHOD LABOR	OTHER METHOD SCRAP CREDIT	OTHER METHOD NET	SAVING	LOSS

SHOP ..... OPERATOR ..... RATE .....
REMARKS .....

FIG 1

ELECTRIC WELDING REPORT

ENG. No. ..... DATE 191
DESCRIPTION:

OTHER METHOD:

TIME CHG. TO JOB	ACTUAL TIME WELDING	POUNDS WIRE USED	COST OF WELDER	OTHER METHOD MAT'L	OTHER METHOD LABOR	OTHER METHOD SCRAP CREDIT	OTHER METHOD NET

WELDER ..... RATE .....

FIG. 2

OXY-ACETYLENE WELDING REPORT

MACHINE AND CAR SHOPS — MONTH OF - AUGUST - 1916

WELDING

ARTICLE WELDED	No. of Operations	Actual Hours Welding or Cutting	Wages of Men for Total Hours	Cost of Gas and all Supplies	OTHER LABOR	TOTAL COST	OTHER METHOD	SAVING or *LOSS*
Bolsters	17	42.0	21.22	97.44		118.86	353.48	234.82
Bands	29	1.5	1.52	3.48		5.00	9.50	4.50
Brake Hanger Arm	1	1.0	.47	2.32		2.79	6.30	3.51
Box Steel	2	1.0	.46	2.32		2.76	- -	*2.76*
Column Posts	5	2.0	.88	4.64		5.52	13.38	7.86
Heating Stud	1	.5	.33	1.16		1.49	1.89	.40
" Step sides	2	.5	.16	1.16		1.32	2.67	1.35
" Truck Side	1	.5	.13	1.15		1.29	2.60	1.31
TOTAL	1184	141.5	77.83	330.60		408.43	1849.18	1460.10
							Loss	*19.35*
							Saving	1440.75

CUTTING

Cutting Angles	290	5.5	5.20	13.26		18.46	28.90	10.44
" Buffer Castings	7	1.0	.80	2.41		3.21	11.22	8.01
" Bolts	10	.5	.48	1.21		1.69	5.42	3.73
" Castings	16	1.5	1.39	3.62		5.01	12.61	7.60
" Center Plates	13	1.0	.51	2.41		2.92	27.70	24.78
" Winding Shafts	12	.5	.66	1.21		1.87	2.36	.49
" Z-Bars	34	1.0	.43	2.41		2.84	7.16	4.32
TOTAL	1041	57.0	47.84	137.42		185.26	408.47	241.96
							Loss	*18.75*
							Saving	$ 223.21
Total Locomotive Shop	6607	345.5	207.71	809.78	218.77	1236.26	1959.62	723.36
" Car Shops	2225	198.5	285.54	1140.38	- - -	593.69	2257.65	1663.96
GRAND TOTAL	8832	544.0	493.25	1950.16	218.77	1829.95	4217.27	2387.32

	OXY METHOD	OTHER METHOD	SAVING
Total Loco. Shop Welding	964.20	1598.71	634.51
" " " Cutting	272.06	360.91	88.85
" Car Shop Welding	408.43	1849.18	1440.75
" " " Cutting	185.26	408.47	223.21
GRAND TOTAL	1829.95	4217.27	2387.32

NET SAVING FOR MONTH - $2387.32

Sept. 26, 1916

Fig. 4

In the case of a cutting job the operator must mark in the second line "cutting," and also the name of the article to be cut and the amount of oxygen and acetylene.

Then comes the monthly statement rendered by the Master Welder. Figs. 3 and 4 show the acetylene welding and cutting record for the locomotive and car shops. Fig. 5 shows the electric welding record of 2-inch and 5-inch flues. Fig. 6 shows the electric welding record of smoke consumer tubes. Fig. 7 shows the electric welding record for the locomotive shops. Fig. 8 shows the current yearly statement of acetylene welding and cutting, showing the total cost of a blow-pipe per hour, welding or cutting, the consumption of material and the amount hours employed in the acetylene welding or cutting, and, finally, the saving obtained from the process.

1916

MONTH	SAVING	Cost Burner Hour Welding	Cost Burner Hour Cutting	Welding Hours Worked	Cutting Hours Worked	Cu.Ft. Oxygen Used	Lbs. Carbide Used
JAN.	$ 2045.10	2.12	2.31	412.2	168.3	48900	4200
FEB.	1813.69	2.22	2.30	444.3	153.8	53250	5000
MAR.	3050 65	2.18	2.37	502.2	141.9	55600	4300
APR.	2223.11	2.25	2.36	453.3	171.6	56800	4500
MAY	3243.71	1.79	2.26	429.0	164.8	41800	3500
JUNE	1986.77	2.26	2.41	388.9	155.5	48200	3200
JULY	2014.83	2.22	2.44	332.7	122.5	38400	3500
AUG.	2387.32	2.32	2.41	395.9	148.1	49600	4200
TOTAL	$18765.18	17.36	18.86	3358.5	1226.5	392550	32400
AV'G	$ 2345.64	2.17	2.35	419.8	153.3	49069	4050

Fig. 8

STATEMENT OF WORK PERFORMED WITH ELECTRIC WELDER

BOILER LOCOMOTIVE SHOP — MONTH OF AUGUST - 1916

2" - FLUES

ENG NO.	DATE	NO. FLUES WELDED	ACTUAL TIME Welding Hrs	Min	LABOR	MAT'L	CURRENT	TOTAL COST ACTUAL WELDING	TIME PREPARING FOR WELDING Hrs	Min	COST Preparing for Welding	TOTAL COST TO ENGINE
4136	8-1	44	4	30	1 67	.25	1.35	3.27	1	00	37	3.64
5562	8-2	144	9	45	3 22	60	2 93	6 75	1	15	.41	7.16
4426	8-3	159	10	30	3.89	65	3 15	7 69	1	15	.46	8.15
4553	8-4	159	11	00	3.83	65	3 30	7.58	1	15	41	7.99
4295	8-4	45	3	00	1.11	.20	.90	2.21	1	00	37	2.58
4594	8-5	285	19	30	7.22	1 13	5 85	14.20	1	30	.56	14.76
4809	8-7	51	3	45	1.39	23	1 13	2.75	1	00	.37	3.12
4413	8-9	159	11	00	3.63	70	3 30	7.65	1	15	41	8.04
4421	8-9	49	3	30	1.30	.23	1.05	2 58	1	00	.37	2.95
4294	8-28	9		30	.17	.04	.13	.36		30	17	.53
5967	8-29	60	4	00	1.32	.25	1.20	2 77		30	17	2.94
4503	8-30	159	10	30	3 78	65	3.15	7.58		30	18	7.76
4801	8-30	27	2	00	.66	14	.60	1.40		30	17	1.57
4872	8 31	37	2	00	.72	.15	.60	1.47		30	.18	1.65
TOTAL		4240	287	40	103.33	18.02	86.30	207.65	28	15	10.14	217.79

5" - FLUES

4136	8-1	25	6	15	2 31	.40	1.88	4 59				4 59
5562	8-2	9	2	15	74	.15	.68	1.57				1.57
4426	8-3	24	6	00	2 22	.40	1.80	4 42				4.42
4553	8-4	24	6	00	1.98	.40	1.80	4.18				4.18
4594	8-5	36	9	00	3 33	.60	2.70	6.63				6.63
4809	8-7	11	2	45	1.02	.20	.83	2.05				2.05
4413	8-9	24	6	00	1.98	.40	1.80	4.18				4.18
4121	8-9	21	5	15	1.94	.35	1.58	3.87				3.87
5959	8-10	34	8	30	3.15	.58	2.55	6.28				6.28
4029	8-26	43	12	00	4.44	.70	3.60	8.74				8.74
5967	8-29	3	1	00	.33	.05	.30	.68				.68
4503	8-30	24	8	00	2.88	.40	2.40	5.68		30	18	5.86
4801	8-30	5	2	00	.66	.10	.60	1.36				1.36
4872	8-31	1		30	.18	.01	.15	.34				.34
TOTAL		491	127	15	46.17	8.18	38.50	92 85	1	00	.37	93.22

Fig 5

SMOKE CONSUMER TUBES

ENGINE NO.	DATE	No. FLUES WELDED	ACTUAL TIME WELDING Hrs	Min	LABOR	MAT'L	CURRENT	Total Cost Actual Welding	TIME PREPARING FOR WELDING Hrs	Min	Cost Preparing for Welding	TOTAL COST TO ENGINE
4136	8-1	8		30	.19	.04	.15	.38				.38
5562	8-2	8		30	.17	.04	.15	.36				.36
4426	8-3	8		30	.19	.04	.15	.38				.38
4553	8-4	8		30	.16	.04	.15	.35				.35
4295	8-4	8		30	.19	.04	.15	.38				.38
4594	8-5	8		30	.18	.04	.15	.37				.37
4809	8-7	8		30	.19	.04	.15	.38				.38
4413	8-9	8		30	.16	.04	.15	.35				.35
4121	8-9	8		30	.19	.04	.15	.38				.38
5959	8-10	8		30	.16	.04	.15	.37				.37
5862	8-10	8		30	.19	.04	.15	.38				.38
5695	8-10	8		30	.18	.04	.15	.37				.37
4409	8-12	8		30	.17	.04	.15	.36				.36
2195	8-14	8		30	.18	.04	.15	.38				.38
4545	8-15	8		30	.18	.04	.15	.37				.37
5887	8-17	8		30	.19	.04	.15	.38				.38
4889	8-17	8		30	.18	.04	.15	.37				.37
5855	8-18	8		30	.19	.04	.15	.38				.38
4128	8-18	8		30	.18	.04	.15	.37				.37
4678	8-19	8		30	.19	.04	.15	.38				.38
4009	8-19	8		30	.18	.04	.15	.37				.37
5843	8-24	8		30	.19	.04	.15	.38				.38
5860	8-25	8		30	.18	.04	.15	.37				.37
4029	8-26	8		30	.19	.04	.15	.38				.38
4294	8-28	8		30	.16	.04	.15	.35				.36
5967	8-29	8		30	.17	.04	.15	.36				.36
4503	8-30	8		30	.18	.04	.15	.37				.37
4801	8-30	8		30	.17	.04	.15	.36				.36
4872	8-31	8		30	.18	.04	.15	.37				.37
TOTAL		272	8	70	5.24	1.16	4.35	10.75				10.75

Fig.6

MISCELLANEOUS ELECTRIC WELDING

MACHINE AND LOCOMOTIVE SHOP — MONTH OF AUGUST - 1916

DESCRIPTION	NO. OPERATIONS	LABOR	MAT'L	CURRENT	TOTAL COST	OTHER METHOD	SAVING *LOSS*
Brake Shoe Heads	213	28.17	5.18	24.48	57.83	65.57	7.74
" Hanger Brackets	4	.53	.08	.71	1.32	1.56	.85
Crank Pin	6	3.00	.90	2.70	6.60	7.32	.72
Crossheads-Piston	27	20.80	5.41	18.03	44.24	152.52	108.28
" -Valves	7	.88	.20	.60	1.68	4.73	3.05
" -Arm	4	1.02	.21	.63	2.06	13.64	11.58
Coupler Pockets	8	3.50	.70	2.33	6.53	45.20	38.67
Deck	6	14.25	3.40	10.50	28.15	227.08	198.93
Driving Boxes	4	3.07	.80	2.55	6.42	70.32	63.90
" Box Hangers	12	1.04	.30	.98	2.32	9.16	2.84
Frames	2	.45	.08	.30	.83	.82	.01
Frame Cross Brace	4	8.63	2.10	5.70	16.43	63.76	47.33
Furnace Bearer	1	1.98	.50	1.50	3.98	36.83	32.85
Eccentric Blades	2	.33	.07	.23	.63	3.76	3.06
" Cranks	2	.85	.20	.60	1.65	25.48	23.83
Guide Bars	40	56.87	17.20	51.45	127.52	254.60	127.08
Spring Saddles	7	1.56	.43	1.45	3.44	16.13	12.69
" " - Driving	4	.66	.10	.45	1.21	10.76	9.55
" " - Trailing	3	2.09	.55	1.85	4.49	36.50	32.01
Spokes-Driving Wheel	2	1.04	.35	1.05	2.44	8.50	6.06
Tumbling Shaft	3	3.25	.85	2.50	6.60	48.33	41.73
Trailer Box Holes	12	.99	.30	.75	1.94	17.72	15.78
" " Keys	19	5.17	1.50	4.50	11.17	24.69	13.52
Tip End Wedge	7	1.56	.40	1.50	3.46	3.64	.18
TOTAL	576	209 63	50.62	170.66	430.91	1471.78	1040.86

NET SAVING FOR MONTH $1040.86

Fig.7.

It would be well for every man that has charge of welding installations to start such a record or a similar one, and the extra cost of paper and labor will be well spent for his and his superiors' enlightenment.

ANOTHER STRAIGHT TALK.

In Which Mr. Fairbanks' Article is Discussed and the Need for Co-operation Shown.

By M. Keith Dunham.

After carefully reading Mr. Fairbanks' article in the February issue in reply, or rather in regard to my "Straight Talk to the Oxy-Acetylene Industry," I am reminded of the rather aged story of the tramp who stood at the front gate, behind which a dog was barking and snarling viciously and at the same time wagging his tail. Upon being asked why he didn't open the gate and come through, the tramp replied that the dog's manner puzzled him; he didn't know which end to believe.

After taking me rather ungently by the hand and leading me through a lot of quotations, inferring now and then things which I did not say or placing certain constructions upon my remarks not intended or not capable of being so construed by a careful reading; telling me naively that Prof. Miller is thoroughly acquainted with welding (which point I did not question); assuring me that the A. S. R. E. is a body of fairly intelligent men (I explicitly said they were highly trained in their own professions); after yanking me backward and forward in a not too friendly manner, Mr. Fairbanks winds up his article by stating that it would not surprise him "to learn that the day is not far distant when the riveted joint will be looked upon as crude and clumsy. * * * * This will come * * * * by co-operation and education with a concerted effort to attain the perfection in this line which has been reached in others in the mechanical field."

Which was exactly the basis of my article. Perhaps in this case 'twould be better to believe the tail and forget the barks except for the fact that Mr. Fairbanks reaches this conclusion after a course of reasoning which is rather

puzzling and portions of which at least must be translated to the average welding man.

It will be remembered that I urged co-operation to effect a better understanding of elemental principles of oxy-acetylene welding among engineers of other professions, giving excerpts from a discussion on welding at the meeting of the American Society of Refrigerating Engineers, and stating that prominent among the members of the society opposed to welding were Prof. Miller and Mr. Fairbanks. I did not question the knowledge of welding possessed by either of these gentlemen as neither took part in the discussion, but I did question the knowledge of those whose remarks I quoted. Mr. Fairbanks said my statements pertaining to the longitudinal seam weld by the elderly gentleman were garbled, but without being specific in any respect as to where they were so garbled.

Is This Garbled?

This elderly gentleman, Mr. Fairbanks assures me is the proprietor of one of the largest boiler, forge and welding shops in the middle West. Well, I knew it when I wrote the article. That was one of the reasons why I stated that engineers, highly trained in their own professions, did not understand the elemental principle of oxy-acetylene welding and Mr. Fairbanks by his inference that because this man does a lot of welding he necessarily knows these principles, emphasizes the truth of my statement.

Let's be a little more specific on this talk. In showing the method of making a longitudinal weld in a pressure vessel, this gentleman went to the blackboard and after first illustrating the V to be made, said that on heavy metal the correct manner of welding was to first add a little metal from the welding rod for the entire length of the seam, then a little more for the entire length, etc., until the right thickness had been made. Then he showed how to weld in the head or bottom, placing it exactly in the wrong location with relation to a bending strain, the dished head or bottom to be welded at the end of the rolled up and welded cylinder. To strengthen this design, he showed a method of lap-welding a reinforcement around the head or bottom and cylinder. Here are certain specific statements. If they are garbled, Mr. Fairbanks should tell us specifically what this gentleman did say regarding these two points. This method of welding was not questioned by any one and presumably the stenographer has the proper record, though the talk alone would be a little difficult to understand without the blackboard illustrations. If Mr Fairbanks thinks this account is garbled, it may interest him to know that some of his fellow members of the society have assured me that this is correct and before my original manuscript went to the publisher, this portion was passed upon by a gentleman present as being O. K.

Some Talk About Thermal Disturbance.

Because this is so does not mean that the A. S. R. E. is made up of a body of men who are dense and I hardly think that many of the members would so construe my article. It does mean that they are lacking in knowledge of elemental principles of welding and I cannot resist the temptation to state that Mr. Fairbanks should himself study these principles before attempting a discussion pertaining to "thermal disturbance in the vicinity of the weld," which translated into the parlance of the welding shop is known as plain "overheating," and with the effects of which good tension welders are familiar. It is not such a fearsome disease; in fact, it yields quite readily to simple treatment. Yet to read Mr. Fairbank's discussion of it one would think that "thermal disturbance in the vicinity of the weld" prohibited all tension welding. Mr. Fairbanks states that my account of the method of making the weld previously referred to was garbled. Presumably he was present. Presumably therefore it met with his approval. Now, assuming that Mr. Fairbanks examined a bursted tank made in this manner, I wonder if he would give the cause as "progressive fatigue," caused by "thermal disturbance in the vicinity of the weld?" Any good practical welder would unquestionably say that a weld made in this manner would most assuredly be "fatigued"—yes, tired to death—and the metal in the vicinity of the weld considerably "disturbed" and after being pushed and pulled around in the manner described most anything would be disturbed.

The plain facts would be that no attention was paid to the effects of expansion and contraction and the weld as well badly burnt. That's practical talk. The principles of Molecular Physics, with which I am supposedly unfamiliar, will be my course of study after I know the fundamentals of oxy-acteylene welding. What's the use of trying to assimilate problems in differential calculas when the fact that ten and ten make twenty is still a bit uncertain?

Practical Understanding First.

Not in the least do I mean that after most of us understand elemental principles of welding, we won't talk about "progressive fatigue" and "thermal disturbance in the vicinity of the weld." I believe the method of teaching simple arithmetic before going onward to algebra is still proper and when we practical fellows understand the manner in which to design the weld, make the weld and after-treat the weld, we'll try and catch up with the advanced students. But isn't it just possible that after we know these elemental rules in welding, the trouble now charged to progressive fatigue and thermal disturbance will disappear? I think so and this thought comes to me after a more intimate association with welding than Mr. Fairbanks has had, the training of a few welders and the examination of a goodly number of welded pressure containers. I never saw a ruptured weld which was not caused by lack of attention to rules of an elemental nature, but then I have been associated with the oxy-acetylene process for only eight or nine years. I came into the fold a year after its introduction into this country so that perhaps I should not question Mr. Fairbanks' opinions after his (so he states) fifteen years' association with the process. Probably it is presumptuous to disagree with one whose "intimate knowledge of and contact with the work in the shop and in service" dates back to a time before the process was in commercial use!

That Adverse Report.

Let's get back to our knitting. I am trying to impress upon the oxy-acetylene industry the necessity of getting together to prevent adverse legislation and urging the necessity of education, not only to workmen, but to engineers of industrial plants. In attempting to show the necessity for this, I stated in my January article that Prof. Miller and Mr. Fairbanks were opposed to welding and I quoted from a report which they had made. Mr. Fairbanks passes this quotation lightly over with the remark that he has no remembrance of it. Perhaps his memory can be refreshed. From the minutes of a sub-committee of the A. S. R. E. of which Prof. Miller was chairman, and which was appointed to handle Massachusetts rules and regulations, I quote the following under date of February 1st, 1915:

"Messrs. Fairbanks and Miller agree that oxy-acetylene welding should not be used for tension work, except very small diameters, say 4 inches. It is not so much that it cannot be done as it is to know that it is done properly. Mr. Fairbanks said he had the best welder in Boston. Welded something last week which appeared good, but proved defective. After welding, work should be annealed. It was thought that this acetylene welding question had been so thoroughly thrashed out already that this committee should positively disapprove of acetylene or fusion welding, even for repairing."

Quite a difference between this report and Mr. Fairbanks' discussion of "thermal disturbance in the vicinity of the

weld." The report is couched in practical language; something was welded which looked all right, but was no good. Inasmuch as the "best" welder in Boston was employed, possibly it was the fault of the engineer, possibly the apparatus was bad or possibly the gas was impure or the welding rod wrong, but probably it is dangerous to use superlatives for the "best welder in Boston" could most certainly make a bond which would hold if the work was capable of being executed by the oxy-acetylene process. I have in mind at least two welders who were in Boston at the time this report was written who could quite safely be depended upon to make a proper weld.

Why limit tension work to four inches? Is it because "thermal disturbance" doesn't take place on such a small diameter or is it because that expansion and contraction effects are less noted on small diameters than on large? In other words, isn't it just a question of unfamiliarity with the elementals of successful welding? And can't this lack of education on the part of engineers in other professions be supplied by the oxy-acetylene industry?

Fundamentals Important.

What's the use of soaring off into a discussion of theories which, while important to the advanced student, are not even understood by the man who must use the process and which are wholly useless until the fundamentals are grasped? I have been in a few refrigerating plants and have associated to some extent with refrigerating engineers. Talking to someone who knew less than I did about refrigerating, I could probably make some impression regarding the importance of the purity of anhydrous ammonia, I could put up quite a talk about the relative merits of distilled vs. raw water ice and give some pointers about proper agitation on the latter system, but confidentially I really don't understand why refrigerating plants have cooling towers.

But there are many excellent organizations in the ice and refrigerating industry, composed of men actively interested in the process, to which I could go and which would undoubtedly supply me with all the necessary fundamental information and after I had absorbed it I would undoubtedly understand why cooling towers are used.

What Answer Would You Give?

A couple of weeks ago a prominent member of the A. S. R. E., a manufacturer of refrigerating apparatus, came to me to discuss my Straight Talk article. Unlike Mr. Fairbanks, he did not question the truth of this article but frankly stated that the refrigerating industry wanted help, that legislation was certain to be passed which would prohibit his using oxy-acetylene welding on much of the work he was now doing. He had tried in devious ways to secure information but could get nothing of a definite nature. He at present uses six torches but frankly admitted that if he understood the process he could undoubtedly use many more. Where could he go to get data of the correct nature? Now the oxy-acetylene industry needs to cultivate men of this build a whole lot more than he needs to cultivate us. We're looking for new fields to open up and neglecting present ones and unless we wake up to the seriousness of the situation and get busy quick on a campaign of co-operation and education, local ordinances, state laws and codes of different societies will prove a barrier difficult to hurdle. Why couldn't we give this manufacturer the information he required? He didn't give a hurrah about medium or low pressure or equal pressure torches. What he wanted was information about the process and as a welding industry we couldn't give it to him because we're asleep, gorged with the business we're doing.

Mr. Fairbanks cites the case of a manufacturer who found it difficult to fill the places of his welders, having tried to break in new men with the result that most of the work so obtained was fit only for the scrap heap and then he wonders how much of that work got out to the user and is now subject to high pressure in every-day service. A situation like this is certainly no fault of the oxy-acetylene process and if there is failure of these joints the fault is directly up to the manufacturer. If he had been educated in the fundamentals of the process, no work would leave his shop for tension purposes which had been improperly welded.

Supervision or Examination Essential.

I cannot agree with Mr. Fairbanks in his stand that he is prejudiced principally because there is "at present in use no reasonably positive method of demonstrating the quality of a particular joint after the fact and without destruction." I wonder if he is also prejudiced against forge welding. He doesn't say he is but is there any way of testing any kind of a weld or braze without destruction? I am inclined to think that this sentence is bound up with the one following of "Find a reliable method of supervision and testing . . ." and if it is, he and I are in hearty accord. We should find a way and find it almighty quick of ascertaining whether men are competent to make tension welds and at the same time find out if the men who employ them are capable of designing tension work which meets the requirements of the oxy-acetylene process. This action should be taken by the oxy-acetylene industry; not by mechanical engineers who do not understand the elemental principles of welding. Let the mechanical engineers tell us what they want in the way of tensility and elongation and if its within reason, perhaps the men of the oxy-acetylene industry can do the rest—providing of course the men of the oxy-acetylene industry can get together.

And Now?

Why all this discussion about Mr. Fairbanks article if we are in accord on what is wanted? Simply because we want these things on record. There's been a lot of talk about the process of oxy-acetylene being unsuitable for this or that. Undoubtedly the process will not do everything but the process has been many times unjustly condemned when the fault properly lay in its faulty application. Getting a man's opinions on paper is a long step toward straightening out misunderstandings and now that we know how Mr. Fairbanks feels (though he reaches his conclusion through winding paths), we can make an earnest effort to "show" him.

Is the oxy-acetylene industry at all alive to the necessity of getting together as I outlined in my Straight Talk article in the January issue? Do they all realize—oxygen manufacturers, dissolved acetylene and carbide men, apparatus makers and dealers, salesmen and good welders—that this subject vitally concerns them? Some of them do but most of them evidently take the attitude that somebody (perhaps I), has some particular axe to grind. Get away from that idea you men in the oxy-acetylene industry and think along these lines: We've got to get together in a truly co-operative manner. Co-operation is the highest state of efficiency. Co-operation means that the whole industry will benefit and that no one men or set of men will benefit out of proportion to the others. This getting together means work of the hardest kind, the elimination first of all of petty feelings and then a strong effort made as a body to overcome prejudices which should not exist, educate not only workmen but engineers in industrial plants, fight unjust and prejudicial legislation and incidentally benefit ourselves by a real exchange of ideas which will lead to an improvement in apparatus. This is not Utopian. It's American, 1917.

I have, since my original article was published, received quite a number of letters and have talked to a number of men in the industry. Let me make short quotations from three of the letters received. The first is from an engineer who has been actively associated with oxy-acetylene welding for ten years:

"The acetylene industry today, as a whole, is going to sleep. They are resting content with their present state of prosperity. This cannot last. There is always a danger in too much prosperity. Prosperous ones get fat and lazy. You know as well as I do that the industry cannot stand still—it has either got to go ahead or is bound to go back; and if some of the people in the oxy-acetylene industry do not show more broad-mindedness than they do at the present time and co-operate for the general welfare of the industry, we are all going to get badly stung by some rival concerns who have more life and go to them than has the acetylene industry."

The second is from the general manager of a gas company:

"You have been brutally frank in stating the conditions that exist today in the oxy-acetylene industry. All of us have been aware that for some time something of a heart-to-heart talk has been very much in need. Apparently everybody in the industry has felt as though they would like to get out and start it, but for some unknown reason everybody has been waiting for someone to lead."

And the third is from the president of an apparatus company:

"Some one or two people always have to start these things and put others in line. . . . I would be glad to co-operate in any way that I can in getting something started on this phase of the business before it is too late."

What are you going to do about it, you men of the oxy-acetylene industry?

THE CHICAGO WELDING INSTITUTE

A practical training school of autogenous welding has recently been opened, known as the Chicago Welding Institute and is located at 522 So. Racine Avenue, Chicago.

A skilled oxy-acetylene welder can command good money now and there is every reason to believe that the development of the process will continue to make the demand for expert operators greater than the supply, as it is now. The field is not only attractive as one in which to engage as a profession, but men in the general mechanical lines, notably

garage owners and repair men will find it to their profit to take a course in welding to perfect themselves in a line of work which is becoming such an important adjunct to their regular business.

The idea of such a school of training has been advanced in the past and makers of welding apparatus have felt the need of it, but mostly they have been too busily engaged in keeping up with manufacturing demands to make a decided move in the matter.

The Chicago Welding Institute is the first real movement of its kind and is going to mean much to the development of the art. It is housed in its own commodious, new building and ample funds are back of it. Within are found the practical atmosphere of the factory, combined with class-room surrounding, for both the theory and practice of welding are taught.

It is interesting to glance through the courses that are given at this school. The complete course takes up the welding of all metals and cutting by the Oxy-Acetylene Process. The time required is about twelve weeks and the moderate fee the student pays for this instruction covers all expenses, including text books, goggles, supplies, etc.

The fact is recognized, however, that a man may not find the general course necessary. He may, for instance, wish to run a job repair shop, specializing in automobile repairing. Or he may wish to qualify for a manufacuring position or to fit himself to repair farm machinery.

These contingencies are met by shorter courses of a month or less and the student majoring in some special line. The tuition for these shorter courses, including materials and supplies, is very small indeed.

Each student learns by doing practical work himself as well as by attending lectures and through the study of practical text books prepared especially for these courses.

The illustrations give a good idea of the completeness of the equipment which is at his disposal. Each student is provided with an oxy-acetylene cutting and welding outfit for his individual use. It is of the best make on the market. At his own bench he carries into practice the things that he has learned in the class-room.

In addition, the school shops take in a general line of custom work which is done by experts in the handling of the welding and cutting torch. In this way the student works in the atmosphere of the modern shop and from the beginning of the course to the end has ample opportunity to observe work of all sorts being done by the flame in the hands of men who know how.

Proper technique is insisted upon and at all times the student is expected to couple with this a fair degree of speed. Enough of such work is required in the course to develop the necessary skill to do satisfactory work in a manufacuring concern. The student is given a diploma only after he is able to pass a very rigorous examination which covers both the knowledge of the subject matter and the ability to do actual work well.

PINION SEATS AND KEYWAYS RESTORED

The restoration of worn pinion seats and keyways by welding is probably quite commonly known, but such success has been attained by this company in this practice that a description of its methods should be of interest, especially to those companies having many of the older types of motor involving the dismantling of the armature and its reassembly when a new shaft has to be installed. To obviate this difficulty and reduce the cost, the oxy-acetylene welder is employed.

Preparatory to welding, the pinion end of the armature shaft is first thoroughly cleaned to remove all grease and dirt. Fire clay is then packed into the core head to prevent unnecessary heating of the armature core, which might affect the winding. The bearing seat of the shaft is also incased in fire clay and wrapped with asbestos paper to protect the surface from the intense heat which must be applied to the pinion seat during the welding operation. As a protection for the operator, a fire-brick oven is built around the end of the shaft. After these preparations have been completed, the shaft is brought to a white heat with a kerosene torch, in which condition the entire surface that forms the pinion and nut seats is built up by welding on vanadium steel and the old keyways are filled in. When the welded shaft has cooled, the armature is placed in a lathe where the pinion seat is turned to the standard size. After a new keyway has been cut the operation is complete.

The total cost of the operation is approximately $7.60.

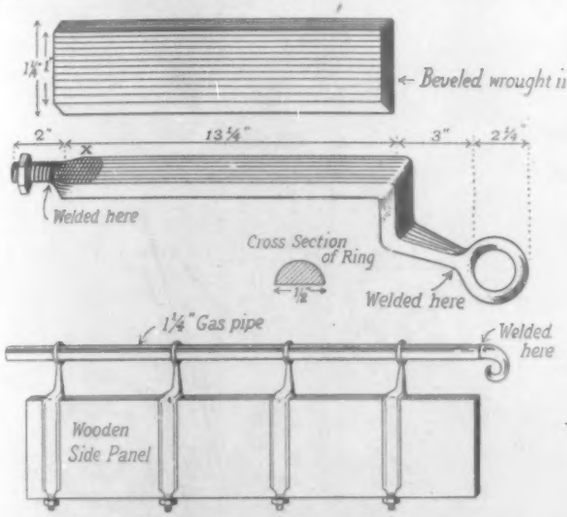
Hints for the Welder

When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way—I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today—the men on the firing line are waiting.

L. B. Mackenzie, Editor.

FORD AUTO PARTS

Editor: We are doing the following work at a St. Louis Plant. The work consists of brackets and gas pipes for hand rails for Ford Auto Carts. After being welded they are polished and highly brass plated. We have done twenty-four hundred of them, two welds on each bracket, making 4,800 welds. I am sending a sketch of brackets, which I



hope will make things more clear. Iron for brackets is 1¼"x ⅛ to 1" beveled. Ring is ½" half round and bolt end of ½". Brackets are forged out by blacksmith to correct size and form, then ring is welded on one end and bolt on other end. Both of which would be impossible to weld on forge. I weld fifty complete in one day, where the blacksmith would be lucky if he made fifteen for the day. Walter G. Wiese.

CARE IN CYLINDER HEATING.

Editor:

Mr. J. W. Gannon's criticism of your reply to inquiries regarding welding of cylinders is not so "muchly" different as he thinks. He lays stress on heating the cylinder, base down. Your answer in each case was to heat evenly and in reply to Mr. Hamilton advised that the heating be where the weld could be made without removing the cylinders from the fire. Mr. Gannon differs then only in the manner of position of cylinders, he stating that he wants the heat to go inside as well as outside. There is much to be said on both sides of this question; but the chief thing, of course, is even heating. Probably, Mr. Gannon can better obtain this even heating by the manner he describes. Other shops do not attempt to heat auto cylinders on the inside and I have in mind one shop which manages to get away with at least twenty cylinders a day without heating the bore of the cylinder except from the outside.

The Buick cylinders he refers to I presume are the famous Model 10. Heating these cylinders properly was a terrific job, due to the varying thickness of metal. Welding an ordinary water jacket break meant that the cylinders were pretty sure to crack open around the spark plug openings, due to the fact that at this point the metal is very heavy and the metal of the water jacket very light, a condition to be dreaded unless proper provision is made in preheating. Welders who studied the construction of this cylinder overcame the difficulty by first making the weld around the spark plug and then welding last the section of equal thickness; or in many instances, the jacket was chiseled in order to allow for the "pull." The welding of cylinders seems to me calls for some knowledge of their construction and then care in preheating. F. C. Sanborn.

DESCRIPTION OF A WELDED STEEL BOX

By O. G. Griffin

The problem of laying a 12" main through a space of 5" between a 20" water main and the concrete roof of the subway recently presented itself and appeared to be a job which would cause considerable delay and expense.

The old method of meeting this condition was to construct a riveted steel box or to have a flat casting made.

Fig. 1.

Both of these methods take considerable time and are quite costly.

The oxy-acetylene torch was brought into play and solved the problem at a comparatively low cost and very little loss of time.

A rectangular box 5" high, 24" wide, and 24" long was constructed of ½" steel plates by setting the plates as shown in Fig. 3 and welding the spaces formed by the adjacent sides.

The next problem to present itself was how to reduce the 12" pipe to the box. As we had no means of lending plates to form such a reducer this appeared to be a difficult problem.

Again it was necessary to resort to the cutting torch and

welding blowpipe. The piece of 12" pipe was cut the same length as the outside width of the box and a steel plate welded in both ends. A piece was then cut from the side of the pipe to admit the end of the box as shown in Fig. 2 and the end of the box to conform to the shape of the pipe.

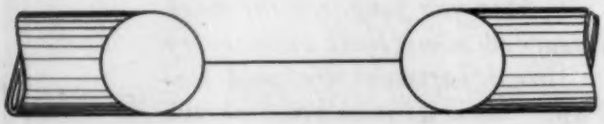


Fig. 2.

It was necessary to make the connection on the eccentric to allow the condensation to flow through the main. The outlet connection was made by a 12x12. See weld on the opposite side of the manifold as shown in Figs. 1 and 2.

The area of the cross section of the box is slightly more than that of the pipe to allow for the resistance caused by the deflection of the gas in passing through the manifold to the box.

Fig. 1 shows the plan and Fig. 2 the elevation.

This peculiar connection was then set in line and welded

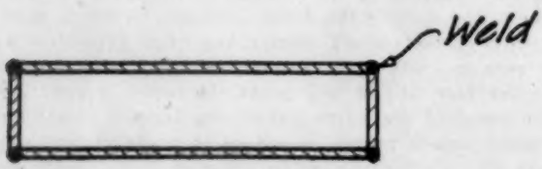


Fig. 3.

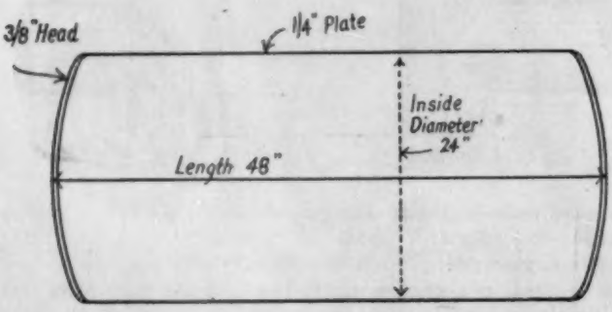
in place at both ends and proved to be very quick and economical means of meeting such an emergency.

It is a very good demonstration of the many and novel uses of the oxy-acetylene torch in meeting an emergency which would prove to be a stumbling block to any of the older methods.

CYLINDER FOR TEST.

Editor:

Find attached a sketch of a cylinder welded for test by Crane Co. of Birmingham, Ala. The dimensions are as follows: 24 in. inside diameter, 48 in. long, made of ¼ in. plate with ⅜ in. heads. Circumference expansion at bursting pressure (which was 1,550 lbs.) was 5⅞ in. This cylinder was welded with American Steel Filler Rods; a lap weld



being made up one side of the cylinder and a butt weld up the other side. The edges of the butt weld were crimped, allowing for more stock. The burst followed from ½ in. to 1 in. along the butt weld side crossing the weld twice, but the welds themselves showed no signs of failure. The supposition is, that crimping the plate before welding, weakened it and caused the rupture to occur at this particular point. This might be of service to the Tank builders.

J. B. Grey.

Editor's Comment:

Here is a job which opens up possibilities of an interesting and profitable discussion among welders with experience in tension work. There are a number of comments we might make but we want to put this up to our readers; afterwards, we'll probably have something to say.

What do you think about the job? Was it prepared the way you would do it? Do you think the pressure it withstood was sufficient to prove welding safe on tension work? If you had a contract to build a tank of these dimensions, would you build it as this, or if not, how would you construct it? In your opinion, did crimping the plate cause the tank to let go?—Editor.

BIG CUTTING JOB.

Editor: We are sending you four photographs of an interesting job of tipping a standpipe over and cutting it up with oxy-acetylene. This standpipe is 110 ft. high and 10 ft.

Large Standpipe Cut Down by Hobbie Welding Plant, Hampton, Ia.

in diameter and took 1,600 ft. of cutting to put it in condition for four men to load it in railroad cars for delivery to the junk man. Total weight 48,600 lbs.

S. W. Hobbie,
Hobbie Automobile Co.

LOCOMOTIVE DRIVE WHEELS

Editor: I note in the February issue of *The Welding Engineer*, Mr. J. W. Gannon, commenting on an article which appeared in the January issue in reference to repairing a locomotive drive wheel, states that a direct idea as to the proper amount needed for expansion is not given. Also that ¼", according to his idea, was too much in the job referred to.

Welding would indeed be easy if the amount needed for expansion and contraction was the same on all jobs and on all occasions.

I will repeat the statement that the operator must use his own judgment and handle the job according to the size of the spoke and the location of the break.

The writer states that a gear wheel 30" in diameter with

two broken spokes was welded and ¼" full allowed for expansion, and that the wheel looked like an eccentric when the job was done. I don't wonder a bit that it did. A locomotive drive wheel and a gear wheel 30" in diameter are two different things and should be handled accordingly.

The spokes in a cast iron drive wheel are quite heavy.

The Standpipe was 110 Ft. High and Weighed 48,000 lbs.

Both ends of the broken spoke must be brought to a red heat before welding is started on a heavy spoke as well as a light one.

Now then, a spoke in a gear wheel 30" in diameter is quite light, compared with the spoke in a cast iron drive wheel, and it requires less heat to bring the ends of the broken

The Standpipe Cut Up.

spoke to the desired heat. A light spoke is also welded in less time then a heavy one.

Iron is a good conductor of heat. If any part of the spoke is kept hot for any length of time, the whole spoke will become hot.

Before the ends of the heavy spoke are brought to a red heat, the heat has traveled away into the spoke, making it hot on both sides of the weld. Before the weld is completed the whole length of the spoke will be hot.

Small Boys Gave Hobbie's Men Their Undivided Attention.

As the expansion increases by added heat, it is easily seen that a heavy spoke, which takes more time to preheat and weld than a light one, also expands more than a light spoke, which is preheated and welded in less time. Hence the amount needed for expansion and contraction must always be based on the operators judgment and skill, and never on a given amount to apply to all cases.

I have welded a number of locomotive drive wheel spokes, the tire being put back without turning the wheel. I have found that $\frac{1}{16}$" allowed for expansion will leave the spoke about $\frac{1}{32}$" long when cool. It may not be necessary to make the spoke longer, but it is better than to have it shorter. Internal strain in anything that is welded is very apt to be a cause of failure.

Only recently I welded one cast iron spoke without cutting the rim, the rim being solid. By heating the rim and the spokes on both sides of the broken one, I got ⅛" for expansion. This being all I could get, the spoke was welded. When cool, the spoke was a trifle shorter than before it was broken. However, the spoke did not break when cooling, but I am not satisfied with the job.

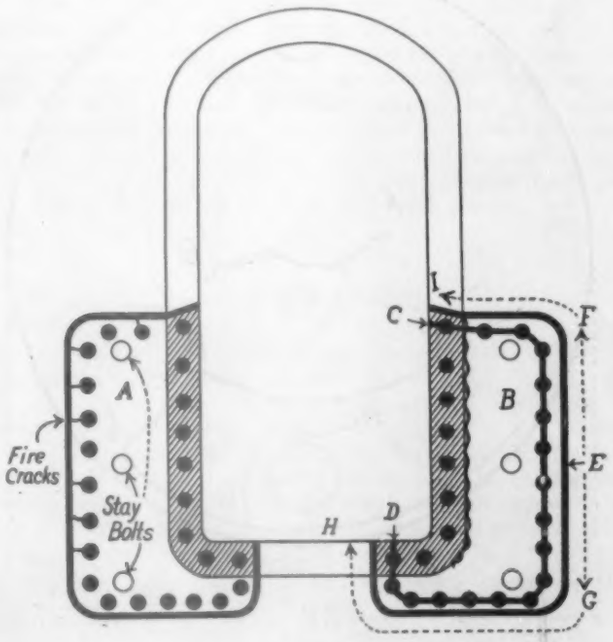
Welding is interesting. There is always something new to learn. The welder is often called upon to do work that other mechanics claim "can't be done." It is interesting to note the rapid progress of the welding industry and how it is developing into a trade of its own. Hundreds of jobs are now done, which only a short time ago were deemed as impossible.

Nels Johnson.

BOILER WELDING

Editor: I am sending in a sketch of a job I did about two months ago, which so far has proven to be a success. Since that I have done another such job with good results. This may be of value to the readers of *The Welding Engineer*.

The patch A shows the rivets and how it was badly fire cracked and caulking edge almost gone, owing to chipping



and caulking up so much, so I decided to cut out and weld in the same patch, the patch being in good condition otherwise. I took my cutter and cut clean through the center of the rivets, patch and sheet, cutting the two laps off, then I took out the three stay bolts. Everything was clear for me to bring the patch in even with the sheet which I did, then the sheet and patch was bevelled to a 45 degree when ready for welding. Fig. B shows just how it looked, showing a part of the rivet hole in both sheet and patch. I put in three small bolts with a large washer on the inside and outside to hold the patch square with the sheet. I then started to weld at C and continued until I reached the point D, lightly hammering the weld as I went along, also warming

the flange at the line Fig. B. When cold I put in the two rivets, top and bottom of the patch in the door flange, then the three 1¼" stag bolts, and the boiler was ready for firing. When running it carries a working pressure of 165 lbs.

If there are any points you could give me on such a job, I shall be pleased to read it in *The Welding Engineer.*

Laurium, Mich. James Renton.

Answer: The idea of using the old patch, provided it is in good condition, is a very good one. However, your method of welding such patches is not satisfactory as it will invite trouble.

The proper method is to tack each patch lightly before welding, then start at E and stop at F. Start welding again at E and finish at G. Then start again at F and finish at I, then at G again and to be finished at H.—Editor.

HOT WATER HEATING BOILER.

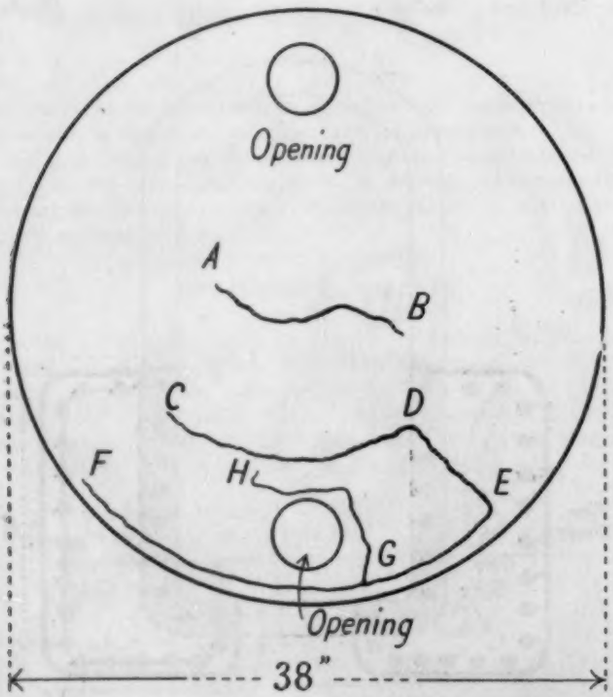
Editor:

Enclosed find sketch of job of welding that I recently did on a part of a hot water heating boiler.

The top of this boiler was blown open by the vent pipe being frozen up.

This casting is 38 inch in diameter and ½ inch thick and the cracks measured in all six feet seven inches.

With a diamond pointed chisel I cut the cracks all out clear



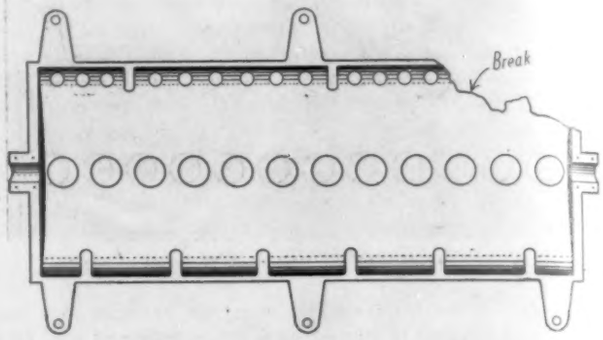
through the metal, then I built a brick oven around it and preheated it with charcoal for about four hours, as it weighed 400 lbs. I welded it in the oven, keeping the parts covered with asbestos as much as possible as I worked. I began at A and welded to B, and then D to C, then from D to E, then from H to G, and last from E to F.

My reason for making the weld from E to F last was I figured that in a casting as large as this one that there would be a large amount of contraction, considering the great area welded over, and this last weld being on the edge as it were, where the top and side meets, it had more chance to give and take without cracking again in cooling. I was careful all the time that I run the metal clear through, and took plenty of time. When done I buried it in ashes in the oven and left it there thirty-six hours to cool, and it was all good and went right back on the job. John Kelley.

ALUMINUM CRANK CASE.

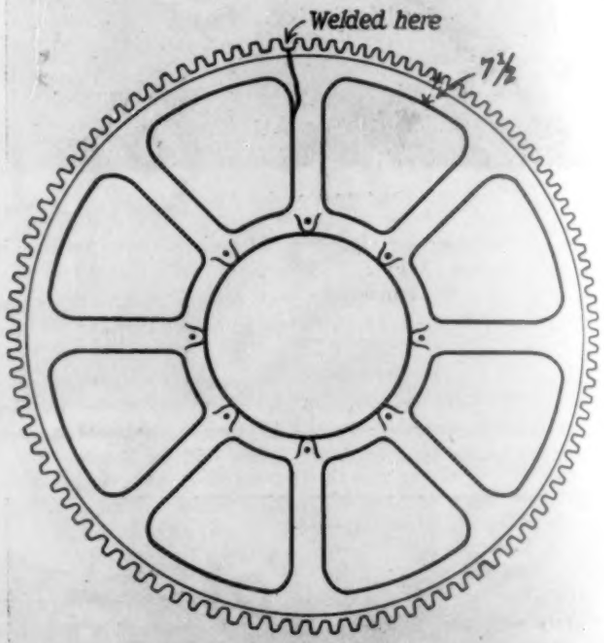
Editor:

I am sending you a sketch of an aluminum crank case. I first preheated and made a plaster of Paris form, building up to hold broken parts, after which I welded. Case is in service and as good as new. John H. Margel.



DIFFERENTIAL GEAR.

This is an illustration of a large differential gear, welded by McColly Bros., Little Sioux, Iowa. The gear is 6 ft. ½ in. in diameter, the cogs being 8 inches wide, weight being 1,600 pounds. The gear was broken through the spoke and rim, the break opening ⅛ of an inch. To close the break two 20 ton jack screws were used, the weld holding very well. The gear is now giving satisfactory service.



PLOWING TRACTORS.

Editor:

I frequently have to weld H beams belonging to plowing tractors. These are about ⅝-inch thickness. The trouble comes when taking these out and replacing them. Would it be advisable to weld these H beams in place, say, by raising the weight of the engine from the beam and reinforcing after welding? This has to be a very strong job because of the vibra-

tion of the slow (comparatively) explosions which are more powerful and irregular than on a car. Any information along this line would be appreciated. The beams usually break about three-fourths down and across the bottom. Anything short of an A1 job would be useless.

I. Jackson.

Answer:

It seems to us that the break can be treated exactly the same as if it were an automobile frame. A reinforcing plate may be put on either the inside or outside, and care taken to weld the break all the way through and to leave no portion of the break unwelded, particularly on the bottom. The plate may be made out of thinner material than the frame, and we should judge that 1/8 would be ample. The plate of course must be welded all the way round, and should be six or eight inches long and nearly as wide as the frame or beam.

Editor.

WELDING—AND OTHER THINGS

Of all the developments in the mechanical line in modern times there is not one that requires more good hard horse sense, or a greater degree of mechanical efficiency, than the art of scientific, or successful welding; and there is no doubt but what the greatest obstacle the welding world has to contend with is the lack of business caused more largely by the fact that so many incompetent men assume that all that is necessary to be a welder is to buy a torch and go after the business. The natural result is unsatisfactory work and the large industries, which are the most profitable customers, soon tire of continued repairs on the same piece of machinery and abandon welding entirely.

In a recent article published in *The Welding Engineer* a writer claims to turn out competent welders in from 2 to 4 weeks time. Such a thing is an absurd impossibility—it simply can't be done—no not even in 2 to 4 months, and the large majority of young men who attempt welding are of less than ordinary ability and never will make competent welders. In the same paper this same writer writes elaborately on welding aluminum, in which he advises that the part to be welded should be preheated until any part of it will melt stick solder, having previously beveled or chamfered, the edges, then proceed as with **cast iron.** Now don't this jar you? It certainly should. While the idea of preheating is not so bad in the hands of a competent operator, but is altogether unnecessary and entirely too hazardous, in addition to which it would require a very elaborate preheating outfit, which very few have or can get. About the time the ordinary welder **thinks** his crank case is about hot enough and starts after his solder to test it a whole slab of that case is going to fall in. In addition to this the case, being of uneven thickness, will most surely warp in cooling. If the gentleman, who turns out competent welders in 2 to 4 weeks time will take two small pieces of cast iron, steel, brass or bronze and melt them with the torch, he will find they will run together and unite just as two drops of water will. That is welding, or more properly speaking, fusion. **Aluminum absolutely will not do this** and while he may hide the crack by smearing molten aluminum over it, he has simply made a bad job worse. For his and others benefit, in another article we give the method by which we weld all kinds of aluminum parts, and since we learned how we never have the least trouble in getting paid for the job, which is the big question.

When we started this little plant of ours we bought out a shop that was being run by some of these two to four weeks graduates. More than half the work done in the shop was stuff that had been previously welded, but failed to hold. We decided that if welding could be done at all it could be done in the first instance and that under no circumstances must a job come back on us, and that if it came back on account of bad workmanship on the part of the welder somebody would get fired. We bought the best welding material that we could find and we do it yet, regardless of price, and instructed our welders that every job must be welded through and through, then built up. We cared nothing about using a little more material than necessary, so long as it was in the line of reason. It is far cheaper to build up and grind off than it is to have to do the work over.

Of course we seldom get any two jobs alike. When any thing out of the ordinary comes in we first map out a theory as to how it should be done. We then search through our Scrap Book and our file of *The Welding Engineer* for any thing we can find bearing on the job in question. Having decided on a plan we do the work. If it proves a success, that theory has become a fact, and in our Scrap Book it goes with a diagram and full description of how we did the work. That old Scrap Book has saved our mutton on many a hard job. Today, we not only have the facilities, but feel competent to take care of any job that comes in, regardless of what it is, provided we consider it worth welding or that it can be done by any one. But under no circumstances will we take a job unless we consider it practical and of some benefit to our customer.

Southern Welding Co.,
J. W. Gannon.

RESISTANCE IN CUTTING.

Editor:

Will you please let me know what material offers the greatest resistance to the acetylene cutting torch.

M. Guber.

Answer:

Wrought iron and steel only respond to the action of the oxygen cutting process. Steel very high in carbon cuts with greater difficulty than mild steel, due to the smaller difference between the melting point of the metal and that of the oxide. In the case of cast iron, where the melting point of the oxide is greater than that of the metal, it cannot be cut by the oxygen process. Speaking in a general way, it might be said that any alloy tending to decrease the melting point of steel would aid in making steel difficult to cut by the oxygen process.

Editor.

ALUMINUM CASE.

Editor:

The enclosed is a sketch of an aluminum case broken on dotted lines. Your advice would be appreciated.

Chas. B. Edinburgh.

Answer:

We see no particular difficulty about the welding of this case. It must be preheated of course, but we really cannot see any reason for any specific advice as there does not appear to us to be anything difficult about the job. If there is any one point bothering you, we will be glad to help.

You will find a welding school listed in the advertising columns of this paper.

Editor.

MANGANESE TUBE

A reader of *The Welding Engineer* recently sent us a couple of pieces of manganese tubing to be welded. For work of this kind we advise the following:

Clean up the edges bright and bevel same to a 45 degree angle. Use a welding head that will carry 8 lbs. oxygen pressure. The welding rod should be 1/8-in. nickel steel. Use a cleaning flux the same as for cast iron.

Lay the tubes on two V blocks and with a neutral flame heat the edges until cherry red. Then sprinkle a little flux at the heated portion. Heat the edges until the metal starts to sweat in form of small drops. At the same time fuse

the welding rod, previously dipped in flux and alloyed together with the fused surface.

When heating the tube keep the inner white jet about ⅛ inch above the metal the same as for cast iron, and do not keep flame at one spot any longer then necessary. As soon as one portion is welded, turn the tube on the opposite side for the same operation, and continue until the weld is finished.

In case the welding rod was not applied at the proper time or flame kept longer than necessary, then the manganese will burn and it will produce a white foam on the surface, the same as white iron. In this case do not attempt to weld that portion, but remove tube on the opposite side for welding. When the welding is finished, then regrind the burnt surface and weld it the same as outlined above.—Editor.

SOLDERING CAST IRON.

Editor:

Is there a method by which cast iron can be soldered, and if so, how? Also, can cast iron be brazed without heating the entire piece to a white heat?

Southern Welding Co.

Answer:

If you can copper cast iron in some way, which you probably can do by the use of blue vitriol, you will be able to tin it and then solder it exactly as you would any other metal. Presuming that this inquiry is for the purpose of filling up scores in cylinders, we notice an advertisement in another trade paper offering full particulars and details.

Referring to the brazing of cast iron: We know of no method of bonding cast iron with spelter unless the article is brought to a very high heat.

MR. RALPH BUTTS.

We advise you, in answer to your letter, as follows:

1. It is not necessary to preheat small castings but as a general rule, it might be said that it is economical to do so, particularly as the castings are of the same general shape or size and a furnace may be constructed cheaply to handle them.

2. Malleable iron cannot be successfully welded. If the defects are discovered before the castings are decarbonized, the welding rod may be of the same material—that is white cast iron. If the welding is to be done after the castings are decarbonized, cast iron makes a nice appearing job but is extremely hard and brittle.

A successful weld may be made, you will see, before the castings become malleable and while they are still white cast iron.

3. Ordinary cast iron flux may be used.

4. Follow the instructions of the manufacturer of the apparatus you use regarding adjustment of the flame and study this portion very carefully.

Oxy-acetylene welding requires study the same as any other trade. Your problems are not difficult, however, as you handle but the one metal and in a week or ten days you should be able to make nice welds.

Editor.

AN EXPANSION PROBLEM.

Editor:

I have noted in recent issues of The Welding Engineer, several discussions relative to expansion and contraction in cast iron and its condition after cooling. I recently observed a jaw welded on a cast iron vise which was about 1¼ inch by 4 inch at the weld. After it was welded and cooled, it had expanded approximately ¼ inch lengthwise across the weld and also about the same in the length of the jaw. This casting was preheated before welding, to save gas. The whole casting was porous and brittle. Would overheating this casting cause this result? This job was done by Mr. O. C. Dobbins of Anniston, Ala. My explanation to him was that castings when run by the foundry were put under a gate or pressure, and the overheating of this casting released the air in the casting, allowing the excess expansion. Kindly advise if I have the wrong impression.

J. B. Gray.

Answer:

We pass this along to our readers for their comment. Frankly, your explanation of the increase is away over our head but we've lived long enough to realize that things aren't always what they seem to be. We cannot help remarking, however, that we would rather attribute this lengthening to error in preparation or carelessness, particularly because the casting increased 1-4 inches in a total length of only 4 inches. Inasmuch as the shrinkage in cast iron per foot is less than the amount you state the casting lengthened and that the casting is only one-third of a foot in length; and because we have learned that the ratio of expansion and contraction is always the same, we simply must call upon our readers for help in solving this problem. How about it?

Editor.

CAST IRON.

Editor: I read with interest each issue of *The Welding Engineer*. W. A. Bennet had the same trouble with cast iron I used to have. No doubt it was cast iron. That grade of cast iron I find is used in castings that require great strength, such as punch presses, etc. I found out that by pulling out that heavy crust and letting it cool it is very hard and brittle like steel might be if it was dropped on a table.

The remedy is a neutral flame and a good strong flux. An ordinary flux will not do. W. F. Dusenbury.

WELDING SMALL COIL SPRINGS

Small Coil Springs can be easily welded in the following manner. Separate the coils as far as possible without straining the tension of the spring. Place a small piece of asbestos paper on each side of the break, in order to keep the heat from reaching the balance of the spring. Place the broken ends together in the right position and make the weld with **soft Norway Iron**—making it somewhat larger at that point than the regular size of the spring. Let cool very slowly. Small flat springs can be welded successfully with the same material. Never use tempered steel, or the spring will be brittle and break easily. Never cool in water for the same reason.

Southern Welding Co.,
J. W. Gannon.

HARD SPOTS IN CAST IRON

Editor: Allow me to voice my opinion on an even more frequent cause for hard spots in cast iron than the ones you speak of in answer to C. B. Ulen. It will be noticed that hard spots occur at the edges of a weld, seldom directly in it. This I believe to be caused by the molten metal coming in contact with the sides of the V (which are cool enough to chill it), and cause hard spots. These hard spots can be removed by slowly moving the flame across the edges of the weld and allowing part of the added metal to flow under the scale which forms on the iron. This precaution should be taken directly after weld is made, without using any more filler rod or flux. I. D. Foster.

ACETYLENE CYLINDERS

Editor: I pulled off a stunt which meant a saving to the company I work for. We are manufacturing a twelve-inch tank with a spun top or head for an Acetylene Gas Co. When spun, the head of the tank is about one inch or better in thickness, where as the body is about three-eighths of an inch in thickness. In spinning there are burrs or overlaps in the heads of some of the tanks. A one-inch pipe and three-eighths pipe tap hole are drilled in the head for valve and fusible plug. The only means they have of getting to this burr or overlap is through this one-inch tap hole.

Formerly they made a tool, bent at 90 degrees with a cutting edge on the bent part, chucked it up in the drill press, bolted the tank on the base of the press and then proceed to back up on the press lever for from two to seven hours in order to cut the burr out. From what I understand they have been using this method for a number of years, doing the work in spare time. The result was that these tanks took up room that could be used to advantage, an enormous output of time and labor with small results, and many broken tools, the wear and tear on the machine and a few swear words.

After thinking the matter over, I suggested a cutting torch with a bent tip to cut out said burrs with gas. My superintendent was in doubt, but told me to look into it. I wrote a friend and he brought up a cutting outfit with a rivet cutting tip. We bent the tip to very near 91 degrees and proceeded. After showing them that my end had been attained from a welders standpoint, the outfit sold itself. I cut out the biggest burrs in less than five minutes. In one day the outfit paid for itself in time saved.

The way I proceed is as follows: Pour a pail of water into the tank and trim the burr with the torch until it is all cut out and the head of the tank on the inside is smooth. The molten metal on striking the water balls up and can be washed out by standing the tank on end and emptying the water. Tanks can then be examined when cold by means of a small electric light, suspended on the inside, and a dentists mirror. A small sketch of the work involved is herewith presented.

S. Kindler.

WELDING ALUMINUM

Aluminum will not weld, or fuse of its own accord, but in the hands of a competent operator broken parts of aluminum can not only be successfully repaired, but made as good, and even stronger than when new. Now if you will place two small pieces of cast iron, steel, brass or bronze close together, so that they touch, and apply the torch you will find these metals will run together, when melted, just as two drops of water will unite when placed together. That is welding, or more properly speaking, fusion. **Aluminum will not do this,** consequently the operator must seek some means by which he can make the parts unite in one solid mass, and that is to **stir** them thoroughly—the more the better. Since we learned how—and every thing we know about welding comes from experience, and our Scrap Book—our method of welding aluminum is as follows. As nearly all aluminum jobs are either crank or transmission cases we will consider that we are at work on one of the former.

We first make a puddling stick. Take a $\frac{1}{4}$" rod about 15 inches long. About 2 inches from one end bend it at right angles, then flatten and sharpen the point like an ordinary fire poker, then put a nice handle on the long end because good tools make good mechanics.

Having thoroughly cleaned the crank case—particularly near the break—we place the same on the forge over a small charcoal fire. Cover it well with asbestos paper and let it "Soak" for about an hour, or until it has gotten thoroughly warm all over. We then gradually increase the heat, keeping the break where it will receive most of the heat, until the entire case is fairly hot all over and will fry oil for some little distance around the fracture, watching it closely all the time lest some of the lower parts, or the top, gets too hot and falls off. This is most important, as aluminum caves in very easily when a little too hot and, of course, when you least expect it. As soon as the entire case is rather too hot to put the hands on the far sides from the fire it is sufficiently limber to take care of the expansion and when the part to be welded will fry oil we bare that part and apply the torch, regulated to the aluminum flame, which is just before it shows the purple tinge around the point of flame. This is most important. We have found it unnecessary to bevel or chamfer the broken edges of aluminum—bring the broken edges to a melt **very slowly** and with the puddling stick dig out the melted aluminum until you are at the very bottom of the crack. Then stir these edges together thoroughly—remember thoroughly—for about one and a half or two inches. Then having gotten your welding rod very hot by holding it in the flame melt a piece about as large as a robin's egg in the channel and keep the edges of case in a melted condition, thoroughly stir with the puddling stick the added metal together with the bottom of and sides of case. Let it go entirely through and **form small bumps on the under side.** Continue in this way, filling up the crack a little above normal until the job is done. We find it a bad idea to attempt to weld aluminum from both sides—it is apt to crack the far end of the weld, or some other part of the case and the little bumps on the under side are most important. They not only indicate that the weld is through and through, but very much strengthen the weld and should be left there unless they interfere with some working part.

They may look a little bad it is true, but nothing looks worse to us than a dissatisfied customer, and the outside can be easily finished up with a coarse file or rasp.

Of course the entire case should be kept well covered—protected from any draft while the weld is being made—only enough left open to enable the operator to do his work.

Remember that cooling is just as important as preheating and the same care should be exercised. As soon as we complete the weld we replace the case over the fire just as we started, and keep a good fire under it until we feel that the welding heat has evenly distributed itself over the case. We then place it under an asbestos lined box and let it cool over night. If the case shows a tendency to warp—which it will not, if properly heated, we do the welding in our face plate—clamping all the edges down tight and if necessary we use the torch on the "bucking side" until it also comes in line. By the time the weld is done it will have "Set" and give no further trouble.

In welding small holes in crank cases or welding on the legs we merely get the case hot enough to be a little limber—just a little warm for the hands—that is all. The use of flux is all right if you have a good one but we do not lay much stress on this. The main thing is to preheat correctly and to thoroughly stir or mix the metal as you go—the more the better. After the weld is made, or rather as you proceed, it is a very easy matter to puddle or flow your metal with the torch, making a very nice finish without further work.

Southern Welding Co.,
J. W. Gannon.

UNDERGROUND CUTTING

Editor: We are sending you today an article which was issued in the *Milwaukee Journal* last Sunday, the 18th of February, where our branch, the Wisconsin Welding & Cutting Co., performed a very interesting piece of work by cutting under compressed air, 85 feet under the ground, in one of the large tunnels in Milwaukee. The Wisconsin Welding & Cutting Co., were cutting in the Locking Piling.

The contract was let out for $500.000 for 40 ft. of cutting. Of course, this was mighty risky business to operate under this compressed air and from the article you will notice what Mr. Hansen and Mr. Johnson from this company have to say. The work was done very successfully. They had a little trouble in getting started as they were using acetylene and you will note in the article that the acetylene refused to work which is due that the acetylene requires considerably more oxygen to burn than the Oxy-hydrogen flame. The result was that the boys had to use oxygen and hydrogen to perform this operation.

The Oxy-hydrogen flame being a vapor flame of course, does not require the amount of air when burning in a tunnel, therefore, it was possible to perform this work.

The writer believes that this article is very interesting and that you may publish same in your Journal for the benefit of the welders and cutters. As no doubt, some of your subscribers, some day may strike the same kind of a job and by using the Oxy-hydrogen flame there is no doubt but that they can successfully operate when doing this work.

Universal Oxygen Company,
H. J. Mueller, Vice-president.

(From *Milwaukee Journal*)

"There are only a few objections to descending into a caisson where the work is being carried on under compressed air. One of these is the 'jimmies.' If a man comes up too fast, so that his lungs and heart have not time enough to adjust themselves to the decrease in air pressure, his joints are likely to 'freeze' into the position in which they happen to be when he strikes the outer air. The 'jimmies' is the reason why a *Journal* reporter declined an invitation to inspect the 85-foot shaft which has been sunk into the bank of the Milwaukee river, forty feet from the intersection of West Water and Fowler Sts. The invitation came from C. H. Hansen, general manager of the Wisconsin Welding & Cutting Co., which contracted to cut a circular opening in the side of the shaft, thirty-five feet below the river level. Into this opening will run one of the branch tunnels of the new sewerage system.

In Compressed Air Chamber

"'Sometimes people get caisson sickness,' said Gustave Johnson, secretary-treasurer of the company. 'Their noses and ears start to bleed. Of course, if a man has a weak heart, it's better not to go down.'

"'We worked from 7 a. m. to 3 p. m. every day without coming out for dinner,' said Mr. Hansen, 'because it's so disagreeable ascending. It takes about five minutes to go down and twenty to come up. The shaft is divided into three compartments by two locks. After passing the first lock into the middle chamber, in going down, the compressed air is gradually turned on until the pressure reaches twenty pounds. Then the bottom lock automatically opens and we descend to the lowest chamber.

"'The compressed air is necessary to keep the sides of the shaft from caving in. As the pressure is increased it is interesting to note how all the moisture on the walls disappears.

Cutting the Steel

"'The cutting is done by Walter Meilordt and me with an oxy-hydrogen flame. We tried the acetyline flame, but the torch blew up. As one works directly behind the torch, there is no way to escape the sparks that rebound from the metal.'

"Mr. Johnson unbuttoned his shirt and showed a chest well blackened by burns.

"'It's pretty tough when a spark gets in your shoe,' he resumed. 'It keeps you hopping.'

"The shaft is electrically lighted by means of a complete plant. It measures fifteen feet square and was formed by driving and interlocking three-foot lengths of steel piling, fourteen inches wide, pumping out the mud, reinforcing it with concrete and boarding it up. According to Mr. Hansen, this is the first compressed air job ever done in Wisconsin. It took about seven days."

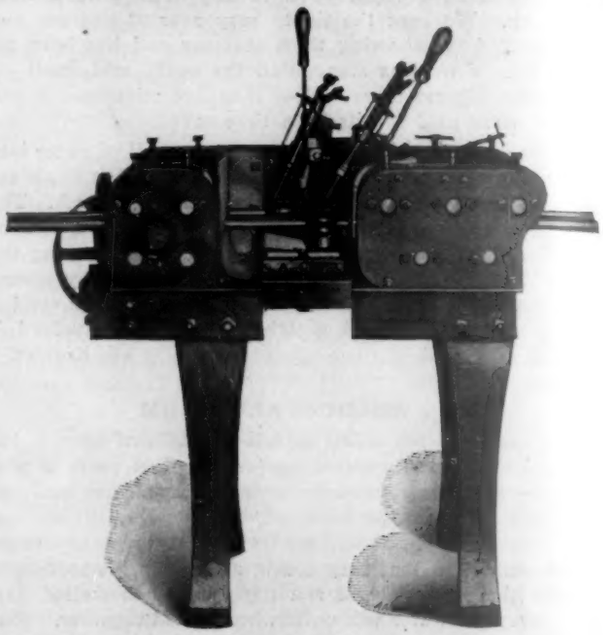
STANDARD THREADS

Editor: Is there a standard for threadshanks in the various welding and cutting torches manufactured in this country, and if so what is that standard? Affinity Spark Plug Co.

Answer: There is no standard.—Editor.

TUBE SEAM-WELDING MACHINE.

The welding machine illustrated here is made by the Thermalene Co., Chicago Heights, Ill., and welds two tubes at once. Thermalene gas is used, generated in one of the company's make of generators. One operator handles two welding machines, which take two tubes each. The machine is built to weld tubing 1¼ in. in diameter, 14 gage, at a speed of from 28 to 34 in. per min. without preheating. With a preheater the speed can be increased to about 42 to 50 in. per min. The torches are water cooled and simple in construction. With 8 lb. pressure of thermalene and 10 lb. pressure of oxygen the estimated cost per foot of tubing welded is 1.1c for gas and oxygen. The thermalene gas mentioned was described in detail in a former issue, and consists of a combination formed by mixing vaporized crude oil and acetylene gas, to which oxygen is added for welding and cutting purposes. The comparatively small amount of oxygen needed gives very satisfactory results in welding work and produces a strong non-brittle weld. Aside from making generators of various sizes for the production of thermalene gas and the burners or torches for cutting and welding, the company also designs and builds on order, automatic welding machines of all kinds, of which the one shown is merely an example. A number of their machines have been in successful use in large pipe and tube-making plants for some time. A number of these machines are being used without preheaters, for various reasons, but where preheaters are used the welding speed can be almost doubled. The company's plant is well equipped to promptly handle orders for both machines and supplies of every description in its own particular line of work.



Wolf's Tube-Seam Welder.

A CORRECTION

In the February issue of *The Welding Engineer*, page 22, illustrations showing an automatic arc controller and a self regulating generator should have been mentioned as being the apparatus of the Arc Welding Machine Co., 220 West 42nd St., New York, N. Y.

THE SUASIC-ARC SYSTEM

The Suasic-Arc Weltrode Co., 61 Broadway, New York, have just issued a new booklet relating to The Suasic-Arc System of Electric Welding. There are 30 pages, fully illustrated, describing the system in detail.

AN UNUSUAL CRANK SHAFT REPAIR.

The high pressure under which the various iron and steel plants have been working during the past year has resulted in the breaking of innumerable rolls, pinions, crank shafts and other machine parts. As in most cases a quick repair has been the first consideration, and with spare parts often unobtainable, the Thermit process has been used on a larger scale than ever before.

The great value of the process was recently demonstrated in the case of the American Car & Foundry Company, at Berwick, Pa. They fractured a large three-throw crank shaft 10 inches in diameter, the break occurring in the crank slab or web, which was 5 inches by 13 inches in size at the point of fracture. This would have been a comparatively simple weld to make had it not been discovered on careful inspection that there were two additional fractures in the shaft, one in the pin journal and one in the adjacent crank web. If each of these was to be welded separately they would have required about 450 pounds of Thermit for each weld, and it would have been extremely difficult to allow for the contraction of the different welds so that the shaft would be in fairly close alignment at the end of the three welding operations. An alternative would have been to combine two of the welds, which happened to be close together, into one weld using 900 pounds of Thermit and then making the other weld separately, but this also would have introduced difficulties in allowing for shrinkage and alignment which it was felt involved too much risk.

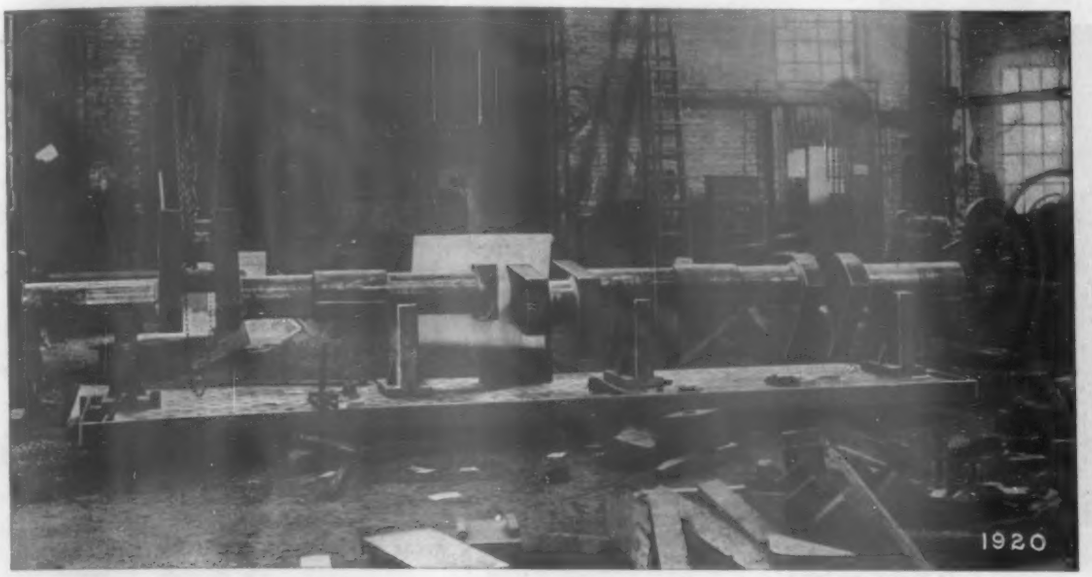


Fig. 1.—Shaft as Originally Prepared for Welding Before Additional Cracks Were Found.

Fig. 2.—Mold Box and Crucibles in Position for Welding New Section to Shaft. 10" Crank Shaft Welded by the American Car & Foundry Co., Berwick, Pa.

It was finally decided to cut out that particular crank throw entirely, and make up a new forging consisting of a pin journal and two crank webs, and weld this section into the shaft proper by means of two Thermit welds. As these two welds would be on the main axis of the shaft, the shrinkage of the metal in cooling would not tend to throw the shaft out of alignment, and the machine work would, therefore, be simplified, and would consist merely of removing the excess metal around the welds, where it interfered with the operation of the shaft, and turning down the pin journal to proper diameter and throw. Of course, this method involved a little delay, but the saving in Thermit was considerable, and the saving in machine work was even more important, while the method offered the advantage that the shaft would be straight and the diameter of the different bearings would not have to be reduced.

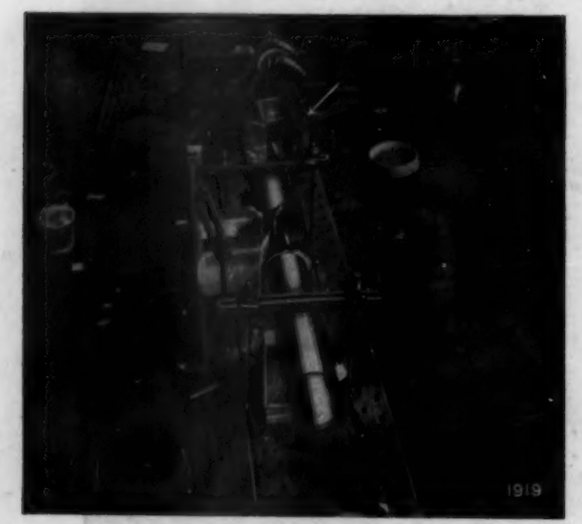


Fig. 3.—New Forging in Place of Welding. The Part Cut Out Is Shown by Arrow.

It was decided to follow this method, and the accompanying illustrations show very clearly the various steps in the operation. Fig. 1 shows the shaft as originally prepared for welding at the time that it was thought that only one weld would be required. This shows the complete break in the crank web and the shaft in process of alignment in V blocks mounted on a machined bed plate. Fig. 2 shows the mold box and crucibles in position for the two welds, which were poured simultaneously. Fig. 3 is a bird's-eye view of the shaft after the new forging had been made and placed in position. Fig. 4 shows the two Thermit welds completed, with the metal left in the pouring gates and risers. After this was cut off the shaft was ready to be machined.

Fig. 4.—10" Crank Shaft Welded by the American Car & Foundry Co., Berwick, Pa., Showing the Two Thermit Welds Before Shaft Was Welded.

WHY BLAME WELDING APPARATUS?

I read with much interest the editorial discussing failures in welding by the oxy-acetylene method, on page 653, Vol. 45. I am strongly in concord with your views, and I think every practical oxy-acetylene welder must be in agreement. It is true, undoubtedly, that "the blame is too often placed on the apparatus," whereas inefficiency or inexperience of the operator is often the cause. Indeed, it may be safely said that oxy-acetylene-welding methods are not generally understood, as making sound homogeneous welds in the different metals is the result of a knack that can be acquired only by exercise of considerable judgment and practice. Obviously, the success of oxy-acetylene welding depends to a very great extent on the intelligence and ability of the operator.

To become proficient in this modern art, skill and training are essentials, together with a knowledge of how to apply the system as well as how to prepare the work to be welded. The operator should, therefore, be well versed in the fundamental principles of the process. He should know how to manipulate the welding flame at the right moment when fusion has proceeded so far that complete welding is assured; he should possess the dexterity that prevents the distortion of the metal under the torch; he should be skilled in the judicious use of the hammer at the right moment on the welded part of certain metals, whereby the strength of the weld is increased. Another important requirement is thoroughly knowing the characteristics of the materials used. This does not necessarily mean the study of their manufacture, but rather that knowledge which enables the

operator to say which material is most suitable for the particular metal being welded.

I agree that this process of welding is unlike the ordinary work of the blacksmith and that it is possible to obtain a sound weld with practice of a short duration on certain metals, mainly because the weld can be built up from its foundation and in most cases can be readily seen, whereby its soundness and strength may be insured, but always provided it is properly and intelligently done.

Some makers of oxy-acetylene welding apparatus are willing to send experienced welders for a few days to their customers' workshops to teach the workman until he has acquired a fair knowledge of the process. Furthermore, the expert welder may be procured later to give assistance, should it be required, a charge being made according to length of service. Frequently, if workmen are left to their own resources, it will be observed that they develop into operators having only a limited acquaintance with the extent or the limitations of the process.

In the selection of workmen to become welding operators there is usually a discussion as to the class of man to choose for the work. Oftentimes, a laborer or a handy man is decided upon. This selection I do not approve of, because as in other skilled trades, it is best to use science in picking workmen to become welding operators. I have found it most satisfactory to choose the best mechanics of the various metal-working trades, such as good blacksmiths or sheet-metal workers, as these men invariably develop into competent welders after several months' training under an expert. By this system I have found that the work turned out is of first quality. Evidently, this is due to their previous knowledge of the characteristics of different metals.

The following is a case in point where unskilled labor was recommended by a firm manufacturing oxy-acetylene-welding apparatus. Some time ago I contemplated welding the roof plates of modern passenger cars, of steel. Several manufacturers were consulted as to the most suitable apparatus and costs. The firm in question wrote: "Regarding the welding operator, it would be best if you would select a workman who has had no experience in welding before, as it is much easier to teach such a man the right way of doing the job than another who has perhaps some idea of welding and thinks himself an experienced welder, but only practices wrong methods." To a certain extent this may be true, as it may be said of other mechanical operations. Generally, however, this type of workman does not compare favorably with the mechanic who has had previous knowledge of metals and how to manipulate them. Indeed, this process of welding may be classed as a scientific art. Consequently, it is necessary to have a thorough knowledge of almost every kind of metal.

In conclusion it may be of interest to mention that, in the early days of oxy-acetylene welding, it was used and advocated for repair work only and for small pieces at that. Now, this process is used for welding all sizes of repair jobs and manufactured articles, the method having been brought to such perfection that there are few metal-working industries in which oxy-acetylene welding does not find advantageous applications.

Manchester, England. E. Andrews.

(From American Machinist.)

A severe test of the ability of the oxy-acetylene welding apparatus was successfully passed at the Vulcan Process Company's shop a short time ago when the broken spindle of a rock crusher was brought in to be welded. This spindle was of cast steel fourteen inches in diameter. Attempts had been made by other outfits to repair this piece but without success owing to the great thickness. They had failed to get sufficient heat to do the job. It was done with a standard Vulcan outfit, however, and is now in use and giving perfect service.

WELDING CONTINUOUS SASH.

The advent of oxy-acetylene gas welding into the general manufacturing field has, in many cases, eliminated the much abused saying "It can't be done."

Quite recently a well known and one of our largest automobile manufacturers commissioned one of our foremost architects to design a power plant.

In keeping with all of his undertakings, this manufacturer

Fig. 1.—Small Panels of First Story Windows.

desired a plant that was "up-to-the-minute" in all respects and one that was original in many respects.

No expense was spared to secure the desired result.

Special windows, to be entirely of steel and glass, and special operators were designed.

Steel plate was substituted where formerly cast iron mullions, imposts and facias were used.

Steel plate panels 21 ft. wide and 53 ft. high made almost entirely of number 12 gauge steel plate were required.

Fig. 2.—Large Mullions in Triple Openings.

It was necessary to make the windows in sections and weld these sections together after the entire frame was set in place.

Illustration shows a section being welded in the factory. These sections were made as large as possible to allow for convenient shipping.

The mechanic is shown welding a muntin in place. This required very accurate and exacting work, inasmuch as the steel sash for these panels had to fit perfectly.

This picture clearly shows how the paneling in the imposts

is made. Steel plate inserts are shown in the impost, welded in place.

Illustration No. 2 shows one of the large mullions in the triple openings. This picture shows the mitering necessary to assemble these frames and gives one an idea of the enormity of designing and laying out that was necessary to complete this work.

Fig. 3.—Method of Assembling Facias.

Illustrations No. 3 and No. 4 shows the method of assembling the enormous facias required for these openings.

Steel plate sheets twelve feet long were used and after the sections were completed, these were welded together.

In illustration No. 4 we see this operation. The mechanic is welding two sections to complete one center panel as shown on illustration No. 5.

The line of this weld is easily followed. When this panel was finished under the emory wheel all trace of this weld was lost.

Fig. 4.—Facias Will be Noted in Place—First Floor in Fig. 5.

Illustration No. 3 gives a splendid view of the method of paneling for these facias. These panels clamped to the base are shown, those at the near end having been completed while those at the far end simply being in position for the welder.

Illustration No. 5 gives us an excellent picture of the finished window. The fine clear cut lines of the mullions and facias are quite a feature of the general design of this building.

Combined with an exceptionally fine design, we have a much lighter and as strong a construction as we could secure with the use of cast iron. Along with this we save considerable over the cost of using the latter material.

In illustration No. 6, we see the method of welding the solid steel sash that are placed in these steel plate frames.

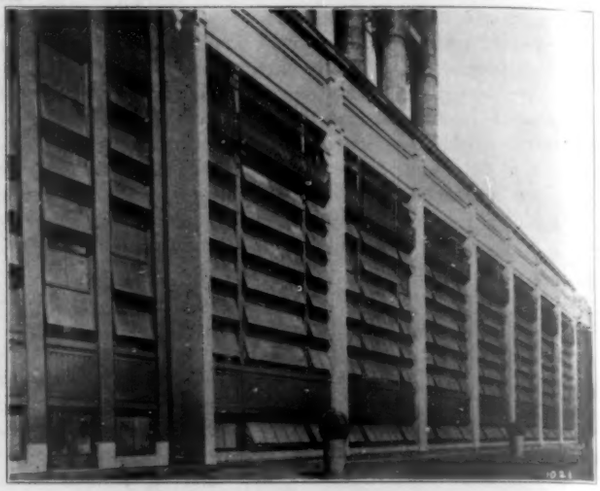


Fig. 5.—Ford Power House.

This sash is made up of special rolled shapes and welded at all points of assembly. This gives us a sash that is practically of one solid piece and makes it far more rigid than if we were to rivet or bolt these joints.

Our observation of sash and frames assembled by the oxy-acetylene process brings out one point that is decidedly in its favor.

Welding Pond Continuous Sash.

Where joints of sash and frames are welded we find that the chance of interior corrosion is reduced to an absolute minimum. This means that we have a window, the life of

Quality = *Guaranteed* = Quantity

Write US About Your Acetylene Supply

Commercial Acetylene Welding Co.

ATLANTA, GA.
AURORA, ILL.
BOSTON, MASS.
BOUND BROOK, N. J

80 Broadway, New York City

PEOPLES GAS BUILDING
CHICAGO, ILLINOIS

EAST DEERFIELD, MASS.
TORONTO, ONT.
SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

which is considerably longer than in the case of a window made of built-up sections, merely riveted or bolted. We also observe that the welded window will not stain the masonry like ordinary built-up sections. This surely is a point in its favor.

In summing up our experience along this line there seems to be but one answer to all of our questions on the subject, and in each case "oxy-acetylene joints" stand out prominently as the deciding feature.

Note—This refers to Pond Continuous Sash—David Lupton's Sons Co., Philadelphia. Editor.

LEAD BURNING.

By James F. Hobart, M. E.

"Lead Burning" is the very poor name which has affixed itself to a very interesting and comparatively little known process of autogeneously uniting lead surfaces. Lead is not "burned" during the process, unless the job be improperly done. If any of the lead be burned the result is inferior work or increased cost of the operation. Lead united by "burning" is joined together in almost exactly the same manner that steel parts are joined by the oxy-acetylene welding process, save that in lead burning lead is used for a "solder stick" and the oxygen tank is replaced by compressed air.

The term "lead burning" is, therefore, a misnomer, and work done in this line should, by all means, be known as: Air-acetylene Welding. Before the advent of acetylene gas lead joining was accomplished by means of a torch much similar to the ordinary welding torch of today, supplied with hydrogen gas through one tube and atmospheric air through the other tube, a pump being used to drive air to the torch.

The hydrogen was usually generated on the spot, a form of generator being used which consisted of two tanks, one

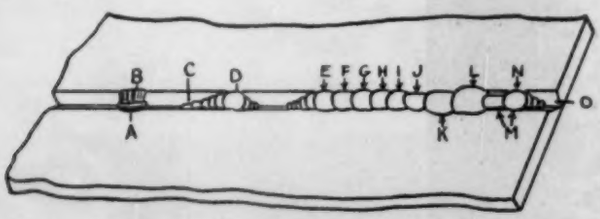


Fig. 1.

above the other. In the lower tank was placed dilute sulphuric acid and upon grating, a few inches above the bottom of the tank, was placed the iron or zinc to be acted upon by the dilute acid.

The hydrogen supply pipe to the torch was taken from the top of the lower tank and a pipe extended from the bottom of the upper tank into and almost to the bottom of the lower tank. Both of these tanks were lead lined and air tight.

The action of the generator was entirely automatic, for whenever a supply of hydrogen was not drawn from the generator, gas pressure accumulated in the lower tank, and the liquid was driven up through the connecting pipe into the upper tank. If no gas was drawn off for some time all the liquid would be thus driven through the pipe, leaving the grating and its iron or zinc bare, when the liberation of hydrogen must necessarily cease.

When a supply of gas should be drawn through the tube to the torch the water and acid would return through the pipe to the lower tank again, and the liberation of hydrogen would be resumed. It should be kept in mind by the operator using one of these hydrogen generators that the hydrogen gas is derived from the water, which is mixed with the acid, but does not come from the acid or from the iron or zinc, whichever may be used.

Hydrogen is liberated from the water when its oxygen is made to combine with the metal, thus leaving the hydrogen free. It is for this reason that hydrogen generators sometimes fail unaccountably to work. The water supply is exhausted and the addition of a new supply of that liquid causes the generator to resume operations at once.

The modern type of lead burning outfit does not require the hydrogen generator. Its bulky, sloppy, smelly nastiness is replaced by a neat, clean cylinder of acetylene gas in some commercial form, and a cylinder of compressed air, when there is no local supply of air at hand, complete the outfit.

Almost any type of torch may be used for "Air-acetylene lead welding," as henceforth we will name the operation. The old fashioned hydrogen-air torch will answer nicely, a common welding torch may be used, but most satisfactory of all is a valveless air-acetylene torch. This style of torch is controlled from a bench block, and enables lead work to be done quickly and well.

When welding lead surfaces the man who has had experience with oxy-acetylene welding on other metals will have little trouble in handling the air-acetylene method, after he learns that much less heat is required for uniting lead. The tendency of the oxy-acetylene man is to overheat and really burn lead, until he becomes accustomed to using hundreds of degrees of heat, instead of thousands.

The beginner in lead work has many things to learn, but

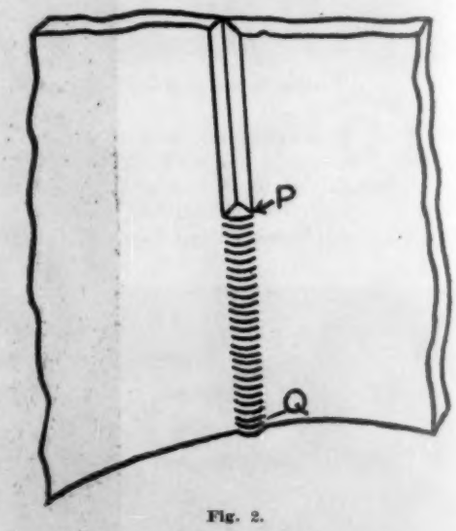


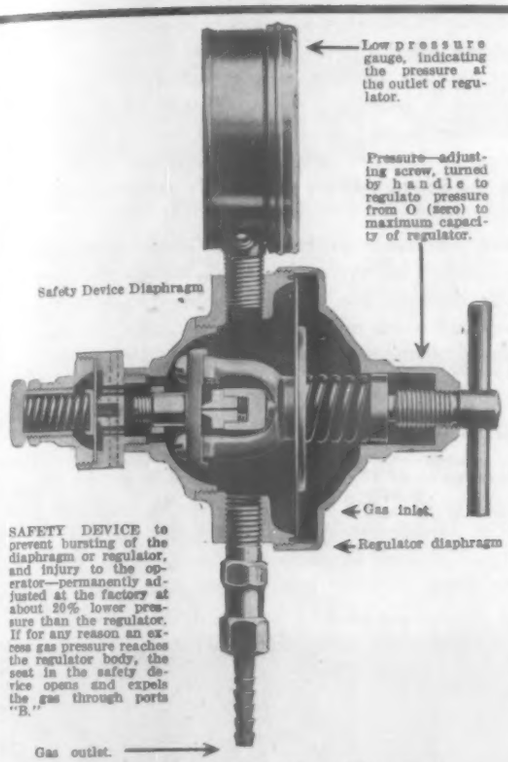
Fig. 2.

each is very simple, easily acquired, and then requiring only lots of practice in order to make the fingers obey the brain quickly and cunningly.

The preparation of lead surfaces for air-acetylene welding is about the same as for steel. In lead work the metals are nearly always comparatively thin. There are few heavy masses of metal to be united. The first thing to do, after the surfaces have been placed in position, is to bevel or chamfer them, as shown at O, Fig. 1. Unless the lead be very thin, indeed, do not try to weld it without first beveling the edges, in order that the welding may be commenced at the bottom, instead of at the top. When the attempt is made to weld thick lead sheets without beveling them, it is found a hard task to drive heat enough to the lower edge of the metal to fuse it there. Driving heat down through a pool of molten metal is not a very satisfying operation, and the welder never can be sure that he has formed a good weld at the bottom. And this point is very important where good work is required.

Having adjusted the flame until it is a very hot, intense little point, proceed to heat the sheets to be united, commencing say at A, Fig. 1, where the heat is allowed to play into the chamfer until both surfaces, at A and also at B, have become heated to the point of becoming liquid. Should more heat be applied, lead would actually run down into the bottom of the chamfer. In fact, a very small puddle of metal is there to be seen.

But at this point, when the chamfer on either sheet has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become liquid clear up to the edge of the solid sheet, and even for a hundredth part of an inch into the solid metal, then arrest further melting of the sheets by introducing a "solder stick," consisting of a strip of the lead which is to be joined together. Strips cut from waste pieces may be used for "solder sticks."

Arrest further melting of the sheets by putting the solder stick into the flame and melting a portion of lead into the chamfer, as shown at C, more and more lead being melted in, until the chamfer is completely filled, as at D. During the time of melting in the extra lead, close watch must be kept of the metal which is being melted into the chamfer, also of both edges of the sheets to be joined, and each must be kept at a temperature which will keep their surfaces liquid and flowing into each other freely. At the same time the heat must be so very cunningly and cleverly regulated that neither surface shall be overheated or melted too much. Here is where the skill of lead welding comes in. Playing the torch flame upon the work just the right length of time, snapping it on and away, as best will keep things heated exactly right, and so the metal from the solder stick will unite and flow into the melted metal of the chamfers—that is what must be done, and is where skill and experience counts for everything.

As soon as one little spot, an eighth or perhaps a quarter of an inch long has been built up in the chamfer, the operation must be repeated again and again, as shown at E, F, G, H and I. It is good welding when the puddles are all of the same size, and all even on both edges, and at the same time perfectly fused into both sheets.

Perhaps a puddle will come out like that shown at J. Here the union is perfect on one side, but not on the other. The top side evidently did not get heated hot enough, the chamfer did not melt, and it is very likely that the metal from the solder stick did not unite perfectly with the metal of the sheet. This is one of the great causes of leaks in welded lead work.

At K a puddle is shown which has been melted too far into the near sheet, but which is seemingly all right against the far sheet. Work of this kind looks bad, but it is solid work, and will not leak. It is far preferable to puddle J or M. Puddle L shows one which has been melted too far into either sheet. It looks bad, but is solid, and aside from its bad looks it represents a waste of time and gas. The beginner should look out for puddles of this kind, which usually are caused by allowing the flame to play too long against the sheets, due probably to inattention to the work in hand, or to pure carelessness. It should be watched for and corrected by the welder who finds himself permitting puddles like L in his work.

Puddle M is bad, very bad. It may be that the metal is solid with both sheets, but being low, the puddle will always be looked upon with suspicion when it is left in this shape, and a good welder will not leave a puddle in that way.

Puddle N is apparently good, but really, one of its kind is not to be trusted. Note that it is nearly round. Both chamfers are melted in the center of the puddle, but there does not seem to be any length to the union. Just a round puddle, and it is very likely that there will be a leak or two between this puddle and the adjacent ones. It is very important that the sides of the puddles be well united with both sheets along the entire length of each puddle.

Fig. 2 shows the manner in which a vertical seam may be worked up. Of course a beginning should be made at the bottom and each puddle carefully and fully melted into each sheet and into the preceding puddle.

Fig. 2—Running a Vertical Seam or Joint.

The thickness of each puddle is necessarily limited to the thickness of melted lead, which can be kept in the joint without running out. Some lead welders, in order to hasten vertical work, which is slower to perform than horizontal work, use a bit of asbestos, which is held outside of the joint, being pressed against both sheets and projecting about a quarter of an inch above the finished portion of the seam. The thickness of puddle is increased, it being kept in place by the asbestos dam. In this manner vertical work can be done almost as fast as horizontal seams, but there is more apt to be leaks found where the dam is used to increase the depth of puddle.

Overhead horizontal work has also been accomplished in the same manner, but the writer does not consider work thus done to be dependable. Means should always be devised, where overhead work must be done, to make the necessary welded seams, then put the sheets in place afterwards.

NEW WELDING BOOK

The very latest of the recent books published on the subject of welding has been written by Mr. P. F. Willis, President of The Henderson-Willis Welding & Cutting Co., St. Louis, Mo. The book contains 182 pages, is fully illustrated, and is free from technical terms. We feel justified in stating that Mr. Willis understands the needs of the welder, and blacksmiths, machine shops, garages and all industries using the oxy-acetylene flame will find this book useful. The first 1,000 copies will be sold at 50 cents each, after which the price will be $1.00. A more complete review will be published in the April issue of The Welding Engineer.

English Girl Welder, at Work on Munitions.

ENGLISH WELDERS

In this column there appears an illustration of an English girl who occupies her time in welding work in an English munition plant. We assume women have been pressed into service because all available men are with the army. We understand Mr. D. Richardson, Editor of the Acetylene Journal (English) has been commissioned, and no doubt when the war ends Mr. Richardson will be in a position to give his American friends much valuable information relating to the training of welders.

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TRADE NEWS

"The Travelers Standard," published monthly by The Travelers Insurance Co., recently published an article on oxy-acetylene welding. The article in question, apparently written by some person acquainted with the welding trade, is both misleading and uninformative.

The Edison Monthly, published by The New York Edison Company, in its issue on February, 1917, contains an article on arc welding. The basis of the article is the devices of the Wilson System of Arc Welding.

Mr. Robert E. Kinkead, of the Lincoln Electric Co., Cleveland, addressed the Power Salesmen of the Commonwealth Edison Co. (Chicago), recently on the subject of Arc Welding.

One of the most striking examples of the economy of oxy-acetylene welding that one could wish is the saving effected by the Twin-City Rapid Transit Co. at their power house in Minneapolis. The burned-out pipes in a super-heater were repaired in less than a day by welding in new pipes with a Vulcan outfit. Heretofore they have been compelled to tear down a great amount of brick work to get the super-heater out and make the repairs. This together with re-installing involved about six weeks' time. Several of the big battery of boilers which they employ have been repaired with the Vulcan and none of them have required more than a day's time. Very little of the brick work needs to be removed as the broken sections are cut out with the torch and new sections are welded in without removing the super-heater.

Classified Ads

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Other Ads—50c per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

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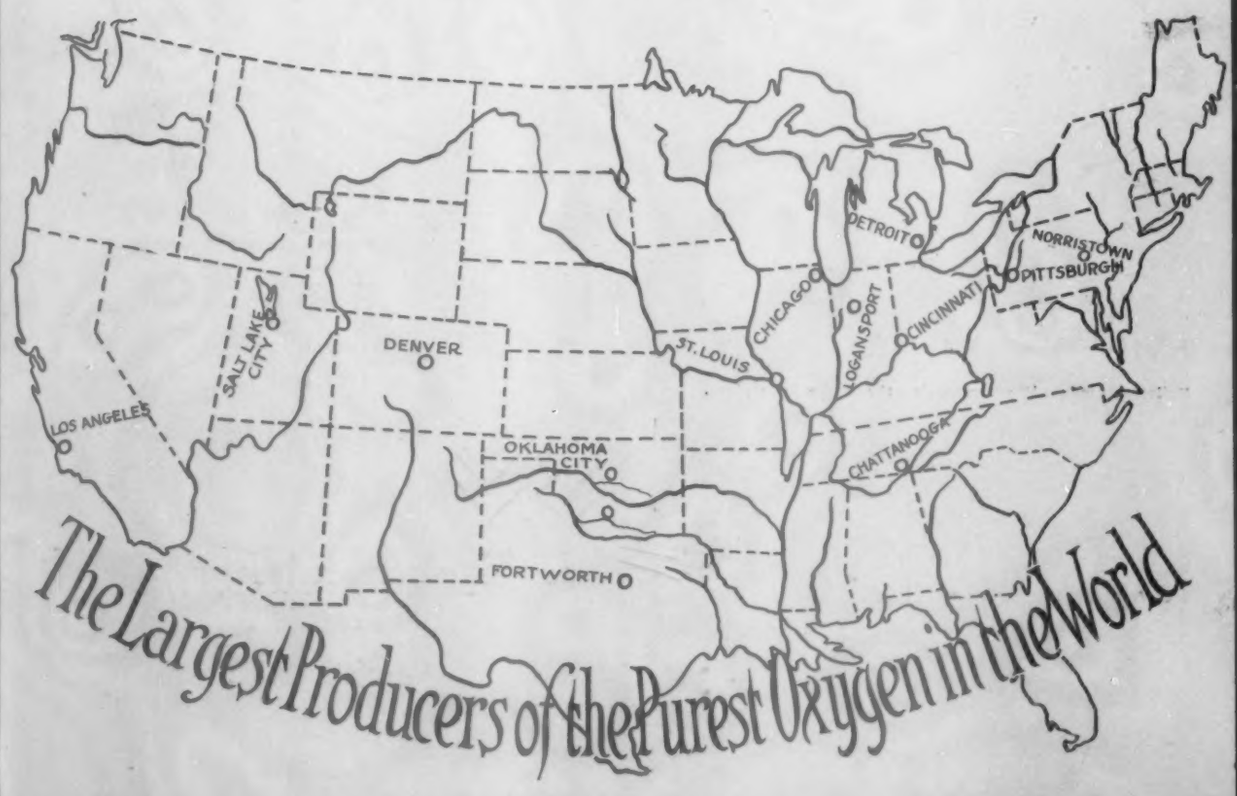

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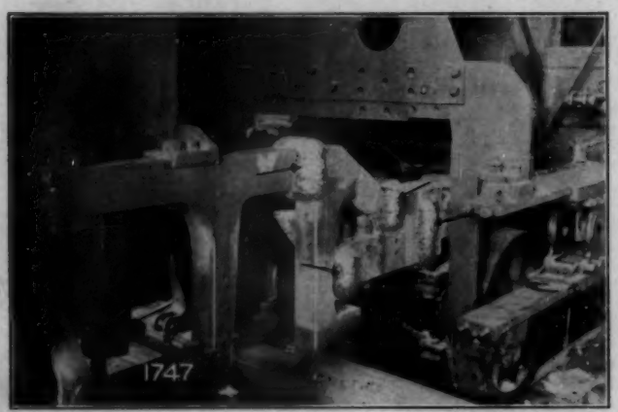
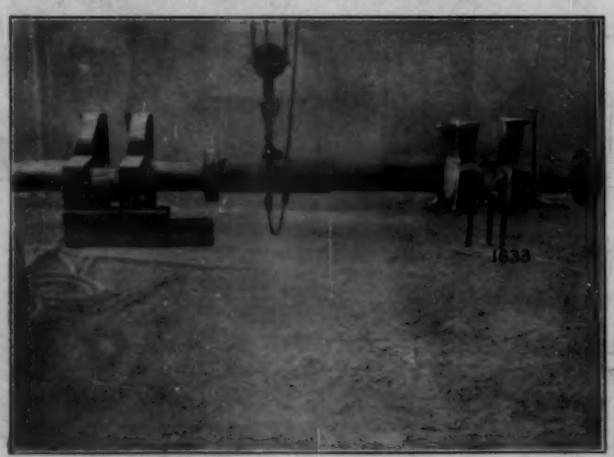


Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.



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